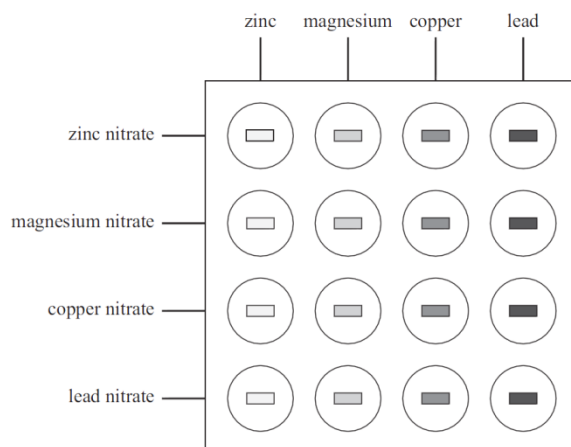


## 90934 Demonstrate understanding of aspects of chemical reactions

### Collated questions on Displacement reactions 2011-2013

#### Question One

A spotting tile was set up, as shown in the diagram, to investigate the reaction of small pieces of cleaned metals with a small volume of different metal nitrate solutions.



- (a) Complete the table below to identify which reactions will occur. The first two lines have been completed for you.

You may refer to the activity series in the resource booklet.

✓ = reaction occurs   ✗ = no reaction

Solutions	Metals			
	Zinc	Magnesium	Copper	lead
Zinc nitrate	✗	✓	✗	✗
Magnesium nitrate	✗	✗	✗	✗
Copper nitrate				
Lead nitrate				

- (b) Identify the type of reaction that is occurring on the spotting tile, and justify your choice by referring to ONE specific example from the reactions on the previous page.

In your answer:

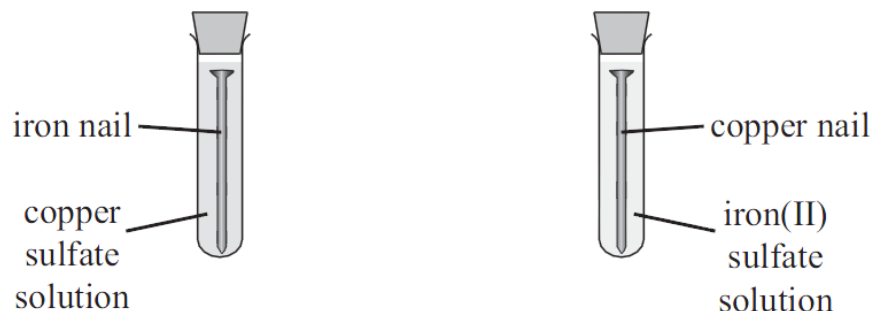
- identify the reaction you have selected
  - describe any observations that would be made in the selected reaction, and link your observations to the reactants and products involved in the reaction
  - identify the type of reaction occurring, and justify your choice
  - write a balanced symbol equation for your reaction.
- (c) Explain why magnesium nitrate solution does not react with any of the three metals zinc, copper and lead.

You may refer to the activity series in the resource booklet.

### Question Two

An experiment in the laboratory involves placing an iron nail in copper sulfate ( $\text{CuSO}_4$ ) solution and a copper nail in iron(II) sulfate ( $\text{FeSO}_4$ ) solution.

Both nails are cleaned with sandpaper, placed in each solution, and the test tubes are stoppered and left overnight.



- (a) Describe any observations that would be made the next day.
- (b) (i) Identify the type of reaction that occurs and give a reason for your choice. You may refer to the activity series provided in the resource booklet.  
 (ii) Write a balanced ionic equation for ONE reaction that occurs.
- (c) Cleaned pieces of the metals iron (Fe), lead (Pb) and tin (Sn) were placed in solutions of iron(II) sulfate ( $\text{FeSO}_4$ ), lead nitrate ( $\text{Pb}(\text{NO}_3)_2$ ) and tin sulfate ( $\text{SnSO}_4$ ), as shown in the table below:

Metals	Solutions		
	iron(II) sulfate $\text{FeSO}_4$	lead nitrate $\text{Pb}(\text{NO}_3)_2$	tin sulfate $\text{SnSO}_4$
iron (Fe)	–	✓	✓
lead (Pb)	✗	–	✗
tin (Sn)	✗	✓	–

– not tested      ✓ a reaction occurred      ✗ no reaction was observed

Use the information provided in the table to place tin (Sn) in the activity series.

Explain your answer.

You may refer to the activity series provided in the resource booklet.

### Question Three

A piece of copper wire placed in a solution of silver nitrate undergoes a displacement reaction.

Give a detailed account of this reaction. You may refer to the Activity series in the Resource Booklet.

In your answer you should:

- describe any observations that would be made
- link these observations to the chemical species involved
- explain why the displacement reaction occurs
- write a balanced **ionic** equation for this reaction.

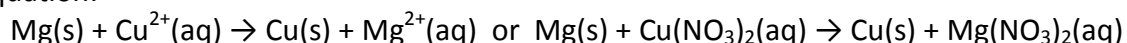
## Answers

### Question One

	Zn	Mg	Cu	Pb
Cu(NO <sub>3</sub> ) <sub>2</sub>	✓	✓	✗	✓
Pb(NO <sub>3</sub> ) <sub>2</sub>	✓	✓	✗	✗

For example: In the reaction between magnesium metal and copper nitrate solution, the grey magnesium metal would (slowly) disappear and an orange / brown deposit / solid / precipitate of copper would form. The blue copper nitrate solution's colour would fade to colourless as magnesium ions displace the blue copper ions from the solution resulting in a magnesium nitrate solution. Since the magnesium has displaced the copper ions (copper in solution) from the solution, this is a displacement reaction (redox).

Balanced equation:



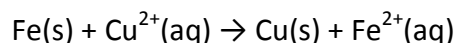
Zinc, copper and lead do not react with magnesium nitrate because magnesium is higher on the activity series, so is more reactive than the other metals. Therefore none of zinc, copper, or lead can displace magnesium ions from solution, so no reaction will occur.

### Question Two

The blue CuSO<sub>4</sub> solution decolourises / fades overnight and the iron nail has a thick pink / brown / orange deposit on it. The iron nail slowly dissolves.

There is no reaction between the copper nail and FeSO<sub>4</sub>.

This is a displacement (oxidation-reduction) reaction as Fe is able to displace the copper ions from solution, as iron is higher than copper in the activity series / iron is more reactive than copper.



Tin fits between iron and lead in the activity series. Iron is more reactive because it displaces both tin ions, Sn<sup>2+</sup>, and lead ions, Pb<sup>2+</sup>, from solution. Lead is less reactive than tin as it will not displace Fe<sup>2+</sup> or Sn<sup>2+</sup>. Tin sits in the middle because it will displace lead ions from solution, but cannot displace iron ions.

### Question Three

A grey / black / silver deposit slowly forms on the copper wire. This is the formation of silver (Ag) as silver ions are displaced out of solution.

The colourless solution will slowly turn blue and copper wire dissolves / decreases in mass. This is because Cu<sup>2+</sup>(aq) ions are moving into solution.

The displacement reaction occurs because copper is more reactive than silver. (Copper is higher than silver on the metals Activity Series.) The copper atoms will form copper ions in the solution, and the silver ions in the solution will form silver metal on the surface of the wire.

