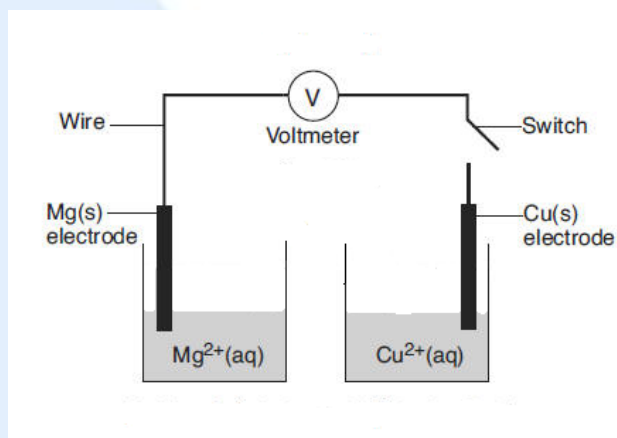


SL HL Paper 3 Section A Experimental work (3) **with worked answers**

A piece of magnesium in a solution of magnesium ions was connected via a voltmeter and a switch to a piece of copper in a solution of copper ions as shown in the diagram below:

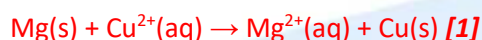


a) State and explain what needs to be added to make this set-up function as a voltaic cell so that that when the switch is closed a reading will be observed on the voltmeter. **[1]**

A salt bridge needs to be added to complete the circuit by allowing the flow of ions between the two solutions. **[1]**

(b) Deduce the direction of flow of electrons in the external circuit and state the overall equation for the reaction that takes place when the cell is operating. **[2]**

The electrons will flow from the magnesium to the copper. **[1]**
 (Magnesium is more reactive than copper so will lose electrons to form magnesium ions and flow through the external circuit to reduce the copper(II) ions to copper metal).



(c) Describe what would be observed when a piece of magnesium is placed into an aqueous solution of copper(II) ions. **[1]**

The solution will lose its blue colour and a reddish brown precipitate will be formed. **[1]**

(d) A voltaic cell is **made** from a zinc half-cell (consisting of a piece of zinc in a solution of zinc(II) ions) and a copper half-cell (consisting of a piece of copper in a solution of copper(II) ions). Use the Activity series given in Section 25 of the data booklet to deduce whether the electromotive force of this cell will be greater or smaller than the cell shown above when both are operating. **[1]**

It will be smaller as zinc is less reactive than magnesium. [1]

(e) Describe what will be observed when a piece of copper is placed in a solution of zinc(II) ions. **[1]**

No change will take place. [1]

(Copper does not react with zinc since it is below zinc in the activity series).