**Part A: Research**

Conduct research on how metals are extracted from their ores by industry, and how the process is adapted when used on a large industrial scale.

* Describe the process for extracting one of the following: Copper, Iron, Lead, Tin, or Zinc from its ore using reduction.
* Describe the process for extracting one of the following: Aluminium or Magnesium from its ore using electrolysis.
* Describe any pollution problems that need to be tackled by industry during these two extraction processes.

**Part B: Carbon Reduction Investigation**Your task during this activity will be to prepare and use a miniature blast furnace to extract a metal from its ore. You will extract copper from copper(II) oxide using carbon reduction.

Write a scientific report of your experiment. Include a description of the procedure, a labelled diagram of equipment, observations, and a description of safety precautions. Include a word equation for the chemical reaction taking place.

You may follow the method described in a chemistry textbook or use the method below.

**Materials required**

* Bunsen burner
* copper(II) oxide
* crucible (with lid)
* carbon powder e.g. charcoal
* spatula (popstick)
* protective mat
* hand-lens
* tongs
* clamp and stand
* safety glasses
* claypipe triangle
* tripod
* tin can with top and base removed
* matches

**Procedure**

**Caution: You must wear safety glasses.**

Be careful of hot objects. If you are burnt, notify the teacher and run the affected body part under cold water for at least two minutes.

Mix about 2 grams of copper oxide with a slightly smaller amount of carbon powder. Place it in the crucible and cover it with a layer of carbon powder to prevent oxidation.

Place the tin can around the crucible to enable the crucible to be heated to a much higher temperature. This will result in larger quantities of copper metal being produced.

The crucible is then heated by the Bunsen burner to red heat for at least 10 minutes. Then allow it to cool and, using the tongs, empty out the contents onto a heatproof mat.

Some powdered copper will be seen at the bottom of the crucible.

The following link provides a method and questions: <http://www.lgschemistry.org.uk/PDF/C1.2_Reduction_of_metal_oxides.pdf>.

**Part C: Electrolysis Investigation**

This process (electrolysis or electrowinning) is used to recover metals such as copper and uranium which are extracted from the ore body by in-situ leaching (ISL). This form of extraction is used in the Beverley and Honeymoon uranium mines in South Australia.

**Materials required**

* Beaker, 250 ml
* Graphite electrodes, about 5 mm diameter, x2
* Retort stand and clamp to hold electrodes
* DC power supply, 6 volt
* Light bulb, small, 6 volt, 5 watt (optional)
* Leads and crocodile clips
* Aqueous copper(II) sulfate, about 0.5 M, 200 cm3
* Small pieces of emery paper

**Caution: You must wear safety glasses.**

At the suggested concentrations, the copper(II) sulfate solution is LOW HAZARD. If the concentrations are increased, the solutions must be labelled with the correct hazard warnings. Copper(II) sulfate solution is HARMFUL if concentration is equal to or greater than 1 M.

Write a scientific report of your investigation.

Include a description of the procedure, a labelled diagram of equipment, and any observations you made during the experiment.

Describe any safety precautions that you took.

Include word equations for the chemical reactions taking place in the process.

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| **Part A: Research** | **4** | **3** | **2** | **1** |
| Describes process of reduction | Metal extraction from ores using reduction is described in a clear and logical sequence. | | Only a basic description of the metal extraction process using reduction is included. | |
| Describes process of electrolysis | Metal extraction from ores using electrolysis is described in a clear and logical sequence. | | Only a basic description of the metal extraction process using electrolysis is included. | |
| Describes industrial scale waste and pollution problems | Identifies waste products of extraction processes and how cleaner emissions are produced at industrial scale. | | Has not identified waste products of metal extraction processes and/or does not include description of industrial scale emissions | |
| **Part B and C: Practical Investigation** | **4** | **3** | **2** | **1** |
| Includes method | Includes clear and complete methods used for in-class practical | | Methods included are either unclear or incomplete | |
| Includes experimental diagrams | Includes clear, correctly labelled diagram of apparatus. | | Diagram is included but unclear or unlabelled | |
| Includes observations |  | | Includes clear and detailed series of observations | |
| Includes chemical reaction and word equations | Description of chemical changes that occur during the process is clear and complete, includes word chemical equations | | Description of chemical changes that occur during the process is unclear or incomplete, does not includes word chemical equations | |