

# Extraction of copper

Possible marking scheme



i. What problem is the Boss of Red Sky Mining trying to solve?

**(Descriptor i)**

- 7-8 **describe** a problem or question to be tested by a scientific investigation
- 5-6 **outline** a problem or question to be tested by a scientific investigation
- 3-4 **state** a problem or question to be tested by a scientific investigation
- 1-2 **state** a problem or question to be tested by a scientific investigation, with **limited success**

7-8 <b>describe</b> a problem or question to be tested by a scientific investigation	The Red Sky Mining company wants to test whether there is more copper in ore that comes from areas with dry climates. In order to mine profitably, they need to find 1.3% of copper within the rocks they mine. They predict that the rainfall in wet climates washes away the copper. They decide to test malachite rock samples from five locations from around Australia where the dampness of the surrounding soil was measured to be: very low, low, medium, high, and very high rainfall. By calculating the percentage of copper in each sample, the Red Sky Mining company can make an informed decision about areas that might prove the most profitable for them.
5-6 <b>outline</b> a problem or question to be tested by a scientific investigation	The Red Sky Mining company wants to test whether there is more copper in ore that comes from areas with dry climates. They decide to test malachite rock samples from five locations from around Australia where the dampness of the surrounding soil was measured. When they find out which one has more copper, they will decide where to mine.
3-4 <b>state</b> a problem or question to be tested by a scientific investigation	The Red Sky Mining company wants to find out how much copper is in ore so they have to test samples from around Australia with different rainfalls.
1-2 <b>state</b> a problem or question to be tested by a scientific investigation, with <b>limited success</b>	How much copper is in malachite in various parts of Australia?

ii. Describe a hypothesis for this investigation using scientific reasoning.

**(Descriptor ii)**

- 7-8 **outline and explain** a testable hypothesis **using correct scientific reasoning**
- 5-6 **outline and explain** a testable hypothesis **using scientific reasoning**
- 3-4 **outline** a testable hypothesis that includes some scientific reasoning
- 1-2 **outline** a testable hypothesis.

7-8 <b>outline and explain</b> a testable hypothesis <b>using correct scientific reasoning</b>	First of all the samples at A,B,C and D must show an unacceptable level of copper in the soil. The samples tested from sites A, B, D and C must show a higher level in the amount of copper in the soil when compared to site E if the Red Sky mine is to be a major suspect. Site E is upstream of the mine and hence not impacted by any potential copper runoff from the mine. If the Red Sky mine is responsible for any toxic levels of copper content in the soil then there should be progressively decreasing concentrations of copper from site A through to D. The further the sample is from the source of the contamination the more dilute the deposit of copper hence there should be a lesser concentration of copper at site D than at site A.
5-6 <b>outline and explain</b> a testable hypothesis <b>using scientific reasoning</b>	The samples tested from sites A,B,D and C must show increase in the amount of copper in the soil when compared to site E if the Red Sky mine is to be a major suspect. If the Red Sky mine is responsible for any toxic levels of copper content in the soil then there should be progressively decreasing concentrations of copper from site A through to D. The further the sample is from the source of the contamination the lower the concentration of copper. Hence site D should have lower concentration than at site A.
3-4 <b>outline</b> a testable hypothesis that includes some scientific reasoning	If the Red sky mine is responsible for copper contamination of the soil then we should see increased levels of copper at all sites tested. The further the site tested is from the mine the lower its concentration of copper in the soil.
1-2 <b>outline</b> a testable hypothesis	If the Red sky mine is responsible for copper contamination of the soil then we should see increased levels of copper at all sites tested.

- iii. Give the dependent and independent variables as well as all the controlled variables in this investigation. Describe how the appropriate variables will be manipulated and how sufficient, relevant data will be collected.

**(Descriptor III)**

7-8 **describe** how to manipulate the variables, and **describe** how **sufficient, relevant** data will be collected

5-6 **outline** how to manipulate the variables, and **outline** how **sufficient, relevant data** will be collected

3-4 **outline** how to manipulate the variables, and **state** how **relevant data** will be collected

1-2 **state** the variables

<p>7-8 <b>describe</b> how to manipulate the variables, and <b>describe</b> how <b>sufficient, relevant</b> data will be collected</p>	<p>The student has correctly identified the dependent and independent variables and described how the dependent variable will be measured and how the independent variable is manipulated. For example- the student must describe that the percentage composition of copper in the rock sample(dependent variable) will be measured through a process of extraction, purification and weighing. A reason as to the random choice of locations for the sampling in each state (rainfall) (independent variable) to give a fair representation of the state's copper deposits is given. The student also describes the need for multiple random samples from each site and how these samples will be manipulated to give one result of percentage copper for the state. At least three other controlled variables are mentioned, detailing how the variables will be manipulated and why these variables need to be manipulated.</p> <p>For example:</p> <ul style="list-style-type: none"> <li>- the depth from which each rock sample is taken needs to be constant. Some rocks, deeper in the ground, might contain more copper than ones near the surface. So if one state has samples taken near the surface while another state has samples taken from deeper in the ground then this will not reflect well on the amount of copper each state has relative to its annual rainfall.</li> <li>- The location of each site needs to be randomly selected so as to not prejudice the results. Samples near large bodies of water may have less copper than other major deposits further inland. If most samples are taken near the coast, for example, then the data will not be representative of the state overall.</li> </ul> <p>These controlled variables may include, depth from which the rock sample is taken and distance from the ocean or large bodies of water that the samples are collected.</p> <p>The percentage composition, by mass, of copper was calculated from the samples collected at each state. Rock samples from each and state were collected and the</p>
<p>5-6 <b>outline</b> how to manipulate the variables, and <b>outline</b> how <b>sufficient, relevant data</b> will be collected</p>	<p>Dependent and independent variables are correctly identified and a brief account is given of how to manipulate the independent variable as well as one controlled variable. A brief account is also given as to how the data is to be collected and the need for multiple sampling points at each site. Two other controlled variables are identified and a brief account of how these controlled variables will be manipulated given.</p>
<p>3-4 <b>outline</b> how to manipulate the variables, and <b>state</b> how <b>relevant data</b> will be collected</p>	<p>The student states the dependent variable(percentage of copper by mass in the rock sample) and independent variable (location). Students also outline how the independent variable is manipulated as well as how one other controlled variable is manipulated. They also state how the relevant data (eg mass of rock sample) is collected.</p>
<p>1-2 <b>state</b> the variables</p>	<p>The student states the dependent variable(percentage of copper by mass in the rock sample) and independent variable (location). They may also state one other controlled variable but do not discuss how it is manipulated.</p>

- iv. Outline a set of comprehensive steps, in dot point, that can be followed to conduct this investigation. Include safety procedures that ensure safe handling of the chemicals provided and disposal of products and a detailed list of chemicals and equipment necessary for this investigation.

*For example – Hydrochloric acid is used. Since acids are corrosive, suggest appropriate precautions when handling acids in the lab. Gases are also produced, discuss some precautions taken when gas is produced.*

**(Descriptor iv)**

- 7-8 design a **logical, complete and safe method** in which he or she **selects appropriate materials and equipment**  
 5-6 design a **complete and safe method** in which he or she **selects appropriate materials and equipment**.  
 3-4 design a **safe method** in which he or she **selects materials and equipment**.  
 1-2 design a **method, with limited success**.

<p><b>7-8</b> design a <b>logical, complete and safe method</b> in which he or she <b>selects appropriate materials and equipment</b></p>	<ul style="list-style-type: none"> <li>- Outlines a complete and logical set of steps that clearly enable others to conduct the experiment in exactly the same way.</li> <li>- Provides a complete set of equipment and materials to be used.</li> <li>- Clearly outlines the hazards when using each chemical or equipment and offers suggestions to minimise the risk.</li> </ul>
<p><b>5-6</b> design a <b>complete and safe method</b> in which he or she <b>selects appropriate materials and equipment</b>.</p>	<ul style="list-style-type: none"> <li>- Outlines a complete set of steps that enable others to conduct the investigation and the steps have some logical progression.</li> <li>- Provides a complete set of equipment and materials to be used.</li> <li>- Clearly outlines the hazards when using each chemical or equipment and offers suggestions to minimise the risk.</li> </ul>
<p><b>3-4</b> design a <b>safe method</b> in which he or she <b>selects materials and equipment</b>.</p>	<ul style="list-style-type: none"> <li>- Outlines a set of steps that enable others to conduct the investigation.</li> <li>- Provides a complete set of equipment and materials to be used.</li> <li>- Outlines some hazards when using the equipment and materials and offers some suggestions to minimise the risk.</li> </ul>
<p><b>1-2</b> design a <b>method, with limited success</b>.</p>	<ul style="list-style-type: none"> <li>- Outlines a set of steps that allow others to conduct the investigation with limited success.</li> <li>- Provides a list of equipment and materials to be used.</li> <li>- Attempts to identify hazards and offers suggestions to minimise the risk with limited success.</li> </ul>

**Command terms**

**State** - Give a specific name, value or other brief answer without explanation or calculation.

**Discuss** - Offer a considered and balanced review that includes a range of arguments, factors or hypotheses. Opinions or conclusions should be presented clearly and supported by appropriate evidence.

**Describe** - Give a detailed account or picture of a situation, event, pattern or process.

**Outline** – Give a brief account