Year 9 Science: **Protection through Electrolysis - Investigation**

MYP 5 Criterion B: Inquiring and designing
MYP 5 Criterion C: Processing and evaluating

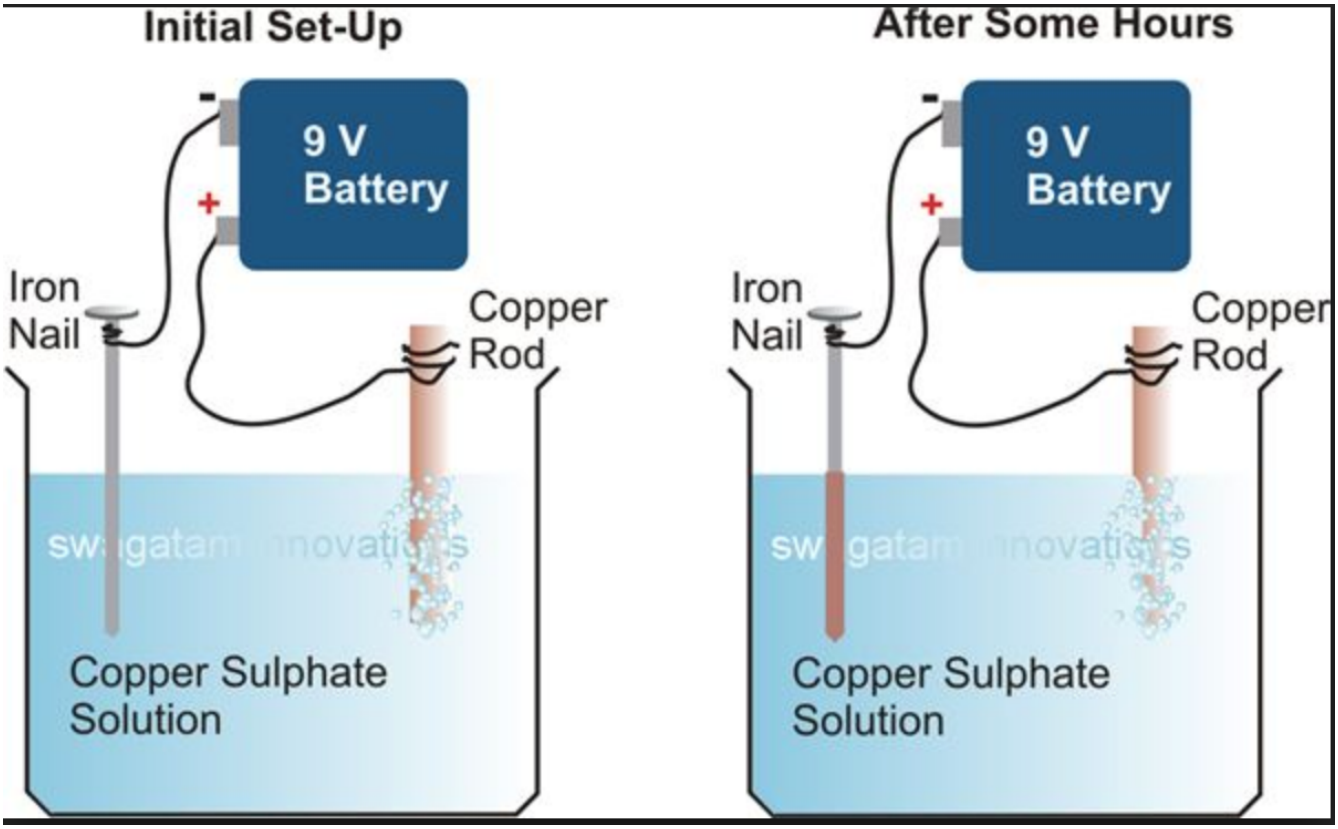
Task
To design a scientific investigation to measure and compare how a chosen factor of electrolysis effects the protection of Iron.

You will be required to formulate a method of electroplating steel by manipulating one of the variables below. You will then leave your metal-plated steel in sodium chloride solution for approximately 3 weeks to determine if your plating successfully protected your steel. You will then check your results and complete your analysis.

2 variables that could be explored are the:

- Voltage
- The time given for the plating reaction to occur (3 mins, 6 mins, 9 mins)

Below is an example of the initial set-up to perform electrolysis (the example is electrolysis using copper)..



Question/ Aim

3-4	5-6	7-8
• Outline the aim of your investigation with reference to the independent and dependent variables. • Give a brief outline of how the information gained in this experiment could be useful in the real world	• Describe the aim of your investigation with reference to the independent and dependent variables. • Describe how the aim will be tested. • Describe ways the information gained from this experiment could be useful in the real world.	• Explain the aim of your investigation with reference to the independent and dependent variables. • Explain how the aim will be tested. • Explain ways the information gained from this experiment could be useful in the real world using specific examples.

Write your answer below.

Variables:

3-4	5-6	7-8
• Outline the independent variable with 3 levels. • Outline the dependent variable and how it will be measured. • Identify 2 factors that need to be controlled and state how they will be controlled. • Units of measurement and exact amounts should be stated for each variable and control.	• Describe the independent variable with 4 levels. • Describe the dependent variable and how it will be measured. • Identify 3 factors that need to be controlled and describe how they will be controlled. • Attempt to describe the possible impact on the data if the controls are not maintained. • State whether the amount of data will be sufficient and why. • Units of measurement and exact amounts should be stated for each variable and control.	• Explain the independent variable with 5 levels and how this is expected to impact the data. • Explain the dependent variable and how it will be measured. • Identify 4 factors that need to be controlled and explain how they will be controlled and the potential impact on the data if they are not controlled. • State whether the amount of data you collect will be sufficient and justify your response. • Units of measurement and exact amounts should be stated for each variable and control.

Independent variable: **Identify** the independent variable and **explain** how it will be manipulated.

Dependent variable: **Identify** the dependent variable and **explain** how **sufficient** and **relevant** measurements of it will be collected during the experiment (incl. equipment and units).

Controlled variables: Identify at least three variables that will be controlled in this experiment. **Explain** how these variables will be controlled to ensure a fair test.

What needs to be controlled?	**How will it be controlled?**	**How would it impact the data if it is not controlled?**

Hypothesis:

3-4	5-6	7-8
• State a testable hypothesis that includes the independent and dependent variables. • Include the word equation for the main chemical reaction. • State how the word equation related to your hypothesis.	• Describe a testable hypothesis that includes the independent and dependent variables. • Include the word equation for the main chemical reaction. • Include a chemical equation for the main chemical reaction. • Describe how the word equation related to your hypothesis using scientific reasoning.	• Explain a testable hypothesis that includes the independent and dependent variables. • Include the word equation for the main chemical reaction. • Include a correctly balanced chemical equation for the main chemical reaction. • Explain how the word equation related to your hypothesis using correct scientific reasoning.

Write your answer below.

Equipment and Method:

3-4	5-6	7-8
• Identify each item required to complete the experiment. • Identify the main safety issues in the experiment. • Identify the precautions that should be taken for each hazard. • Write a complete method in numbered steps, including how the dependent variable will be measured.	• Identify each item required to complete the experiment with sized and quantities. • Identify the main safety issues in the experiment. • Describe the precautions that should be taken for each hazard. • Write a complete method in numbered steps, including sizes and quantities of equipment, and how the dependent variable will be measured. • Your method should have a basic diagram of the experimental set-up.	• Identify each item required to complete the experiment with sized and quantities. • Identify the main safety issues in the experiment. • Describe the precautions that should be taken for each hazard and how the hazards will be minimized. • Write a complete method in numbered steps, including correct sizes and quantities of equipment, and explain how the dependent variable will be measured. • Your method should have an accurate diagram of the experimental set-up.

Equipment: **List** all the appropriate pieces of science equipment and objects that will need to be used in this experiment. Do not forget to include the number required, amounts or volumes, sizes etc.

Safety considerations: **State** the safety precautions that will be taken when carrying out this experiment.

Hazard	Safety precautions

Method: **Design** a **logical**, **complete** and **safe** method - use dot points or numbered steps. Add more dot points if you need them.

1.
2.
3.
4.

Example of a very basic method. You will need to adapt this to your particular experiment and make it much more specific.

1. **Collect equipment and set up electrolysis as shown on the front page.**
2. **Place copper plating solution into the beaker.**
3. **Connect copper metal and steel metal to power pack (as shown in the diagram)**
4. **Turn power pack to 2 volts and allow electrolysis to continue for 3 mins.**
5. **Turn power pack off and remove steel (it should be coated with copper).**
6. **Repeat steps 4-5 but continue the reaction for 6 mins.**
7. **Repeat steps 4-5 but continue the reaction for 9 mins.**
8. **Submerge all three pieces of steel (plain steel, copper coated using copper sulphate and copper coated using copper plating solution) into a beaker/jar full of sodium chloride solution.**
9. **Observe any changes after 3 weeks.**

Results:

3-4	5-6	7-8
• Include a table of the data • Include a graph of the final results • Write a short description of what the table and graph show	• Include a table of results showing the change in weigh of iron • Include an appropriately labelled graph showing the change in weight of iron. • Write a description of what the table and graph show.	• Include a correctly labelled table of results showing the change in weigh of iron with calculations • Include an appropriately detailed labelled graph showing the change in weight of iron. • Write a correct description of what the table and graph show.

Table:

Graph:

Discussion:

1. Interpret your data

3-4	5-6	7-8
• Accurately interpret the results to state the outcome of the experiment • Give reasons why the results came out the way they did	• Accurately interpret the results to describe the outcome of the experiment • Give reasons why the results came out the way they did using scientific reasoning	• Accurately interpret the results to explain the outcome of the experiment • Give reasons why the results came out the way they did using correct scientific reasoning

Write your answer for Question 1 here:

2. Did your results support your hypothesis? Explain through justifying the validity of your hypothesis

3-4	5-6	7-8
• State whether the results support the hypothesis or not. • Describe the data that showed whether the data supported the hypothesis.	• State whether the results support the hypothesis or not. • Describe the data that showed whether the data supported the hypothesis.	• State whether the results support the hypothesis or not. • Describe the data that showed whether the data supported the hypothesis. • Explain whether your hypothesis was written in a way that could be successfully tested

Copy and paste your hypothesis from the first part of the report:

Write your answer for Question 2 here:

3. Justify the validity of your method

3-4	5-6	7-8
• State whether the method allowed you to get enough data to draw a proper conclusion. • State whether the measurement method was appropriate for this experiment and give some reasons.	• Outline whether the method allowed you to get enough data to draw a proper conclusion. • Describe how much data would be needed to make a proper conclusion and why. • Justify whether the measurement method was appropriate for this experiment.	• Discuss whether the method allowed you to get enough data to draw a proper conclusion using appropriate examples from the experiment. • Explain how much data would be needed to make a proper conclusion and why. • Assess whether the measurement method was appropriate for this experiment and explain why or why not.

Write your answer to Question 3 here:

4. Are there any improvements or extensions you could include to improve your practical? Explain your answer

3-4	5-6	7-8
• Identify 2 possible problems with the method that would affect the results. • Suggest how the 2 possible problems could be fixed.	• Describe 3 possible problems with the method that would affect the results. • Suggest how the 3 problems could have affected the data. • Describe how the 3 possible problems could be fixed.	• Explain 4 possible problems with the method that would affect the results. • Suggest how the 4 problems could have affected the data. • Explain how the 4 possible problems could be fixed.

Write your answer to Question 4 here:

Conclusion:

1. **Restate the aim of the practical**
2. **Describe whether the aim was achieved.**
3. **State whether the results supported the hypothesis or not.**
4. **State the conclusion you can draw from the results.**

Write your conclusion here:

Year 9 Science: Protection through Electrolysis investigation - Assessment

MYP 5 Criterion B: Inquiring and designing

Achievement level	Level descriptor	Task-specific clarification
0	The student does not reach a standard described by any of descriptors below.	You did not reach a standard described by any of the descriptors below.
1-2	The student is able to: • state a problem or question to be tested by a scientific investigation • outline a testable hypothesis • outline the variables • design a method, with limited success.	You were able to: • State a question to be tested that contains the IV and the DV • Outline a hypothesis that can be tested • Outline the IV, DV and at least 3 CVs • Design a method which may be incomplete.
3-4	The student is able to: • outline a problem or question to be tested by a scientific investigation • formulate a testable hypothesis using scientific reasoning • outline how to manipulate the variables, and outline how relevant data will be collected • design a safe method in which he or she selects materials and equipment.	You were able to: • Outline a question to be tested that contains the IV and the DV • Formulate a testable hypothesis that includes some scientific reasoning • Outline how to change the IV, measure the DV and control the CVs, and outline how to collect data relevant to the question • Design a method that is safe and contains the materials and pieces of equipment.
5-6	The student is able to: • describe a problem or question to be tested by a scientific investigation • formulate and explain a testable hypothesis using scientific reasoning • describe how to manipulate the variables, and describe how sufficient, relevant data will be collected • design a complete and safe method in which he or she selects appropriate materials and equipment.	You were able to: • Describe a question to be tested that contains the IV and the DV • Formulate a testable hypothesis and explain it using scientific reasoning • Describe how to change the IV, measure the DV (incl. equipment and units) and control the CVs, and describe how to collect data relevant to the question • Design a method that is complete and safe and contains all the materials and pieces of equipment (number required, amounts or volumes, sizes etc).
7-8	The student is able to: • explain a problem or question to be tested by a scientific investigation • formulate and explain a testable hypothesis using correct scientific reasoning • explain how to manipulate the variables, and explain how sufficient, relevant data will be collected • design a logical, complete and safe method in which he or she selects appropriate materials and equipment.	You were able to: • Explain a question to be tested that contains the IV and the DV • Formulate and explain a testable hypothesis that includes correct scientific reasoning • Explain how to change the IV, measure the DV (incl. equipment and units) and control the CVs, and explain how to collect enough data relevant to the question • Design a method that has steps outlined in the correct sequence that is complete and safe and contains all the materials and pieces of equipment (number required, amounts or volumes, sizes etc).

MYP 5 Criterion C: Processing and evaluating

Achievement level	Level descriptor	Task-specific clarification
0	The student does not reach a standard described by any of descriptors below.	You did not reach a standard described by any of the descriptors below.
1-2	The student is able to: • collect and present data in numerical and/or visual forms • interpret data • state the validity of a hypothesis based on the outcome of a scientific investigation • state the validity of the method based on the outcome of a scientific investigation • state improvements or extensions to the method.	The student is able to: • Collect and present data in a simple table or graph, although there may be some errors • Interpret the data collected • State whether the data collected supports or does not support the hypothesis based on what happened in the experiment • State whether the method allowed enough valid data to be collected to answer the question based on what happened in the experiment • State limited improvements or extensions to the method.
3-4	The student is able to: • correctly collect and present data in numerical and/or visual forms • accurately interpret data and explain results • outline the validity of a hypothesis based on the outcome of a scientific investigation • outline the validity of the method based on the outcome of a scientific investigation • outline improvements or extensions to the method that would benefit the investigation.	The student is able to: • Correctly collect and present IV changes and DV measurements in a simple table or graph (incl. title, headings for the IV and DV) • Accurately interpret the data collected and explain results • Outline whether the data supports or does not support the hypothesis based on what happened in the experiment • Outline if the method allowed enough valid data to be collected to answer the question based on what happened in the experiment • Outline improvements or extensions to the method that would benefit the investigation.
5-6	The student is able to: • correctly collect, organise and present data in numerical and/or visual forms • accurately interpret data and explain results using scientific reasoning • discuss the validity of a hypothesis based on the outcome of a scientific investigation • discuss the validity of the method based on the outcome of a scientific investigation • describe improvements or extensions to the method that would benefit the investigation.	The student is able to: • Correctly collect and present IV changes and DV measurements in a clear, labelled table or graph (incl. title, headings, appropriate units) • Accurately interpret the data collected and explain results using scientific reasoning • Discuss whether the data supports or does not support the hypothesis based on what happened in the experiment • Discuss whether the method allowed enough valid data to be collected to answer the question based on what happened in the experiment • Describe specific ways to improve or extend the method that would benefit the investigation.
7-8	The student is able to: • correctly collect, organise, transform and present data in numerical and/or visual forms • accurately interpret data and explain results using correct scientific reasoning • evaluate the validity of a hypothesis based on the outcome of a scientific investigation • evaluate the validity of the method based on the outcome of a scientific investigation • explain improvements or extensions to the method that would benefit the investigation.	The student is able to: • Correctly collect and present IV changes and DV measurements (averages have been calculated) in a clear, labelled table or hand-drawn graph (incl. title, headings, correct units, line of best fit) • Accurately interpret the data collected and explain results using correct scientific reasoning • Evaluate whether the data supports or does not support the hypothesis with reasons based on the data • Evaluate if the method allowed enough valid data to be collected to answer the question based on what happened in the experiment • Explain specific ways to improve or extend the method that would benefit the scientific investigation.

Guide to key words and concepts

CV	Controlled variable – the CVs are kept constant during the investigation
DV	Dependent variable – the DV is measured during the investigation
Design	Produce/create a detailed method to use to test the hypothesis
Describe	Give a detailed account of a situation, pattern or process without explaining why it exists
Explain	Give a detailed account of the causes or reasons for a situation, pattern or process
Fair test	The test of the hypothesis is a method with one independent variable
Formulate	Express clearly using the correct scientific language
Hypothesis	Provide an initial answer to a clear question that can be tested by carrying out an experiment. The hypothesis should be explained using correct scientific reasoning. May take the form of an *If …. then …* statement e.g. *If* the temperatures increases *then* water evaporates faster.
IV	Independent variable – the IV is changed during the investigation
Logical method	The method is correct sequenced and it is outlined using dot points or numbered steps
Materials	Pieces of science equipment and chemicals or objects needed to carry out the investigation
Manipulate	To change or keep constant
Method	The procedure or the way of doing an investigation
Outline	Give a brief description
Purpose	The aim of the investigation
Question	A question that connects the independent variable to the dependent variable
Relevant data	The information collected is related to the investigation
Reliable data	The DV is measured more than one before the IV is changed again. This permits an average of the data to be collected, which represents a more reliable measurement of the DV
Safe method	The method does not place anyone in danger
Select	Choose from a list or group
State	Recall a specific name or give brief answer without giving a reason or explanation
Sufficient data	Enough data is collected to answer the question