Extraction of copper from its ore.

Our ability to find, access, and change the ores deep beneath the Earth is fueling the unprecedented global development in technology with grave consequences for the environment.

A geologist holds samples of Malechite. Malechite is an ore that contains copper in the form of copper carbonate ($CuCO_3$).

An **ore** is defined as a deposit, mainly rock or sediment, that contains a sufficient quantity of a mineral, usually a metal with social and economic importance, that can be economically extracted from the deposit.
Extraction usually involves mining and then further purifying until a pure sample of the metal is obtained.
Before a deposit is mined scientists test a sample of rock to see if it has sufficient quantities of the required metal to make it's extraction economically feasible.

Ore deposits mined for copper typically contain very small percentages of the metal, say around 0.7%. This particular ore, that you are given to test, comes from a place in Australia where the rock is hard to dig into and heavy and expensive equipment is required. With this in mind the ore needs to have at least 2.2%, by mass, of copper metal in it to be economically viable.

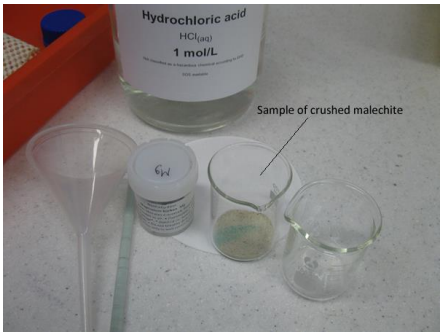
Given a sample of crushed rock containing malechite you are asked to determine if it is economically feasible to mine this ore.

Construct a photographic flow chart of the procedure you will use.

Document every step clearly and in detail as you will be required to explain the reasons for your step and any errors that may have occurred. Use photography to document the steps in your procedure.

The malechite rock is finely crushed before processing. Explain why this is necessary.

On the right is the equipment that you are provided with.
- 60 mL from stock solution of 1.0 M HCl (hydrochloric acid)
- funnel + 2 X filter papers
- 2 X 100mL beakers
- glass stirrer
- 8 X 2 cm strips magnesium ribbon
- electronic balance (to three decimal places)
- distilled water bottle



Lesson 1

Insert your pictures in the boxes on the right.

Picture of beaker and ore sample

Step 1 Weigh the beaker with the crushed sample.
- *record the mass of the beaker and sample of ore.*

1 mark

Step 2 Add 60 mL of acid to the crushed ore and stir the mixture.
- *Is there a chemical reaction taking place? Explain why*

Picture of beaker with ore sample and acid added.

2 marks
- *What is the gas given off? How did you identify it?*

2 marks
- *Describe how the clear acid solution changed. Explain your observation.*

2 marks

Step 3 Work out a way to separate the sand from the solution.
- *Where is the copper in the sand and water mixture?*

1 mark

Picture of how you intend to separate the mixture

- *Can you decant? Explain why/why not*

2 marks

Step 4 Place the wet sand in the container provided for you. Wash and dry the beaker. Weigh the beaker using the same electronic balance as before.

Picture of the beaker with the scale reading.

- *It is suggested to you that you dry the beaker thoroughly. Explain why this is important and give one consequence of weighing the beaker when it is wet.*

2 marks

Lesson 2

Step 5 Place 7 -8 pieces of magnesium strips into the blue solution in the beaker.

- *Give a detailed account of your observations.*

Picture of magnesium ribbon in the copper ssolution

What do you observe happens to the colour of the solution? Give a possible explanation.

2 marks

- *Is this a chemical reaction? Explain why*

2 marks

Step 6 Weigh a dry filter paper using the electronic balance.

1 mark

Step 7 Filter the contents of the beaker through the filter paper. Thoroughly rinse with distilled water.

Picture of the washed, pure copper in the filter pape.r

Lesson 3

Step 8 Allow the filter paper and its contents to dry overnight and reweigh.

1 mark

Step 9 Calculate the mass, in grams, of pure copper extracted from the rock sample. Show all calculations
(mass of filter paper and pure copper – mass of filter paper)

2 marks

Step 10 Calculate the percentage, by mass, of copper in the rock. Show all calculations

$$\frac{\text{mass of copper}}{\text{mass of rock}} \times 100 = \quad \%$$

2 marks

All correct/ relevant photos 2 marks

Some relevant photos 1 mark

Total possible marks for observations 24 marks

Provide an answer to the following questions.

1) What is your recommendation to the Chief Executive (Boss)?
   Is this a viable venture? Give details to justify your recommendation.

   2 marks

2) In step 7 it states to rinse thoroughly with distilled water.
   a) Why is this necessary?

   1 mark
   b) John calculated that his sample of rock contained 5.3%, by mass, copper. John did not rinse the copper in the filter paper with distilled water at step 7. Is the real percentage of copper in the sample less than, greater than or equal to 5.3%? Explain your answer.

   2 marks

3) What is a "*metal* ***displacement"*** reaction and where was it used during this procedure?

   2 marks

4) During this procedure you produced two types of gases, carbon dioxide and hydrogen gas. Both gases are colorless and odorless. Describe a method by which a student can identify each gas.

   2 marks