

Limiting and excess reactants: quantitative

These questions are designed to help you to develop mental models (pictures in your head) of the number of moles of reactants that actually react compared to the number of moles of reactants that are in a beaker. Use the icon in the margin to find out which level of understanding the question is developing.



Macroscopic: what we can see. Think about the properties that we can observe, measure and record.



Sub-microscopic: smaller than we can see. Think about the particle or atomic level.

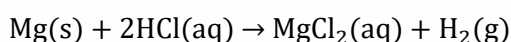


Symbolic: representations. Think about how we represent chemical ideas including symbols and diagrams.

Questions



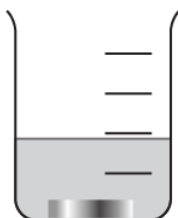
1. Magnesium reacts with hydrochloric acid to form magnesium chloride solution and hydrogen.



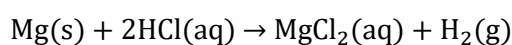
This balanced chemical equation does not show what is in the container at the end of a reaction.

- (a) Explain why hydrogen is not found in the beaker at the end of the reaction.

- (b) The diagram shows what is observed at the end of the reaction.



Circle the substances in the chemical equation that are in the beaker.

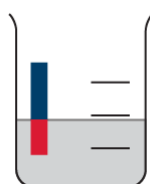


(c) The reactant that is still present at the end of the reaction is called the excess reactant. Name the excess reactant.

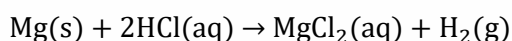
(d) The reactant that had completely reacted is called the limiting reactant. Name the limiting reactant.

(e) The reaction is repeated but with a smaller piece of magnesium.

The diagram shows what is now observed at the end of the reaction. Blue litmus paper dipped into the solution turns red.



Circle the substances in the chemical equation that are now left in the beaker.

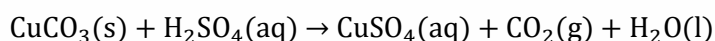


(f) Name the excess reactant.

(g) Name the limiting reactant.



2. Copper carbonate reacts with sulfuric acid to form copper sulfate, carbon dioxide and water.



A beaker contains 0.025 moles of sulfuric acid.

0.02 moles of copper carbonate powder are added.

(a) Give the number of moles of sulfuric acid in the beaker. _____ moles

(b) The balanced chemical equation shows that each mole of copper carbonate reacts with one mole of sulfuric acid.

Write the number of moles of sulfuric acid that react with the 0.02 moles of copper carbonate in the box.

0.02 moles
copper carbonate

reacts with

_____ moles
sulfuric acid

(c) Is this more or less than the total number of moles of sulfuric acid in the beaker?
Circle your answer.

more less

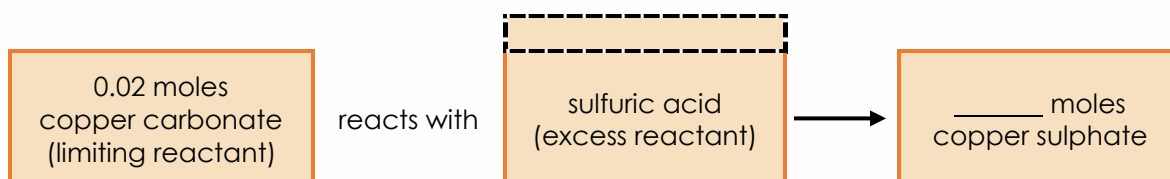
(d) Describe what the dotted rectangle represents.

(e) Name the excess reactant.

(f) Calculate the number of moles of sulfuric acid that remain at the end of the reaction.

(g) Name the limiting reactant.

(h) The limiting reactant limits the number of moles of product that can be formed.
The balanced equation shows that one mole of copper sulfate is formed for each mole of copper carbonate that reacts.



Determine the number of moles of copper sulfate that can be produced from 0.02 moles of the limiting reactant. _____

(i) The experiment is repeated but 0.03 moles of copper carbonate are now added.
The number of moles of sulfuric acid in the beaker is still 0.025 moles.
Add the number of moles of copper carbonate that react with 0.025 moles of sulfuric acid to the diagram.



(j) Is this more or less than the number of moles of copper carbonate in the beaker?
Circle your answer.

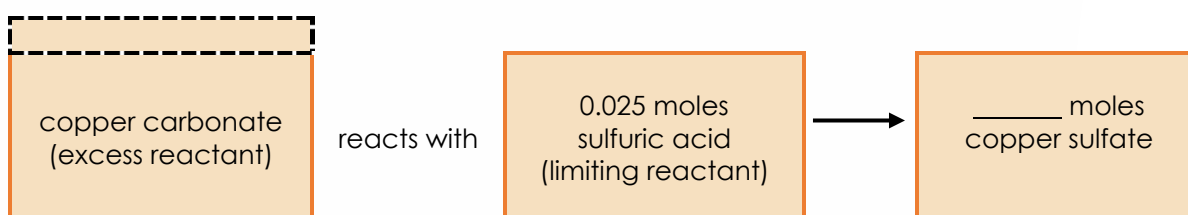
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(k) Name the excess reactant.

(l) Name the limiting reactant.

(m) The balanced chemical equation shows that one mole of copper sulfate is made from each mole of sulfuric acid that reacts.

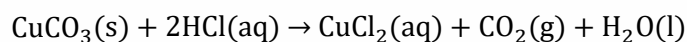
Add the number of moles of copper sulfate that are produced.



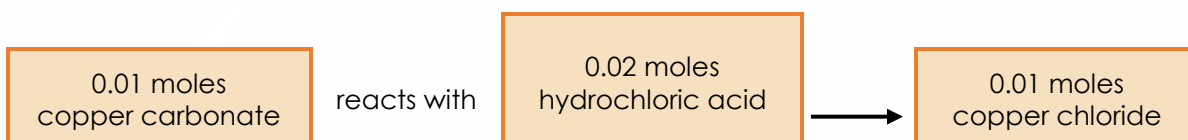
(n) State which reaction (the first or second) makes the most copper sulfate product.



3. Copper carbonate can also react with hydrochloric acid. This forms copper chloride, carbon dioxide and water.



(a) 0.01 moles of copper carbonate is added to a beaker containing 0.02 moles of hydrochloric acid.



The number of moles of hydrochloric acid is more than the number of moles of copper carbonate.

Explain why the hydrochloric acid is not in excess.

(b) Explain why the number of moles of copper chloride formed is 0.01 moles.

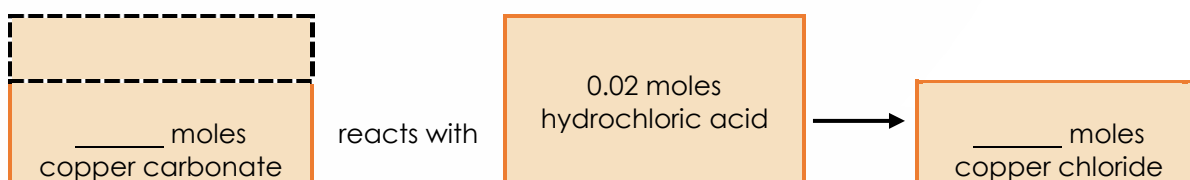
(c) Two learners are each trying to make the largest mass of copper chloride.

Learner A adds 0.02 moles of copper carbonate to 0.02 moles of hydrochloric acid.

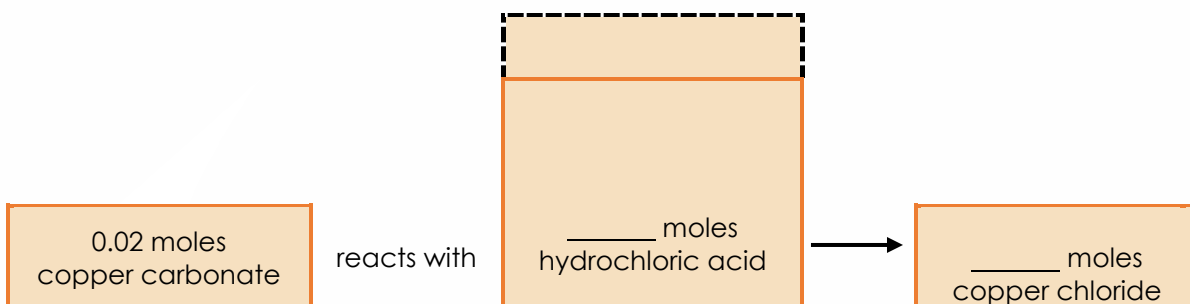
Learner B adds 0.02 moles of copper carbonate to 0.05 moles of hydrochloric acid.

Complete the diagrams to show the number of moles of copper chloride made by each student.

i. Learner A



ii. Learner B



(d) Determine which learner made the largest mass of copper chloride.
