Follow the Electrons

Explain a reaction, then revise a claim about its products.

CH.PS1.2 "Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, knowledge of the patterns of chemical properties, and formation of compounds."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline observations, circle clues about outer electrons or periodic trends, and number the steps that connect electron transfer to the products.

What Makes the Bubbles?

1. A strip of magnesium dropped into dilute hydrochloric acid soon fizzes and becomes smaller. A student first claims that the bubbles must be chlorine gas because the acid contains chlorine. But the visible fizz alone does not identify a gas. In this reaction, the bubbles are hydrogen gas, H_2, and the clear liquid contains dissolved magnesium chloride, $MgCl_2$. To explain those products, look beyond what is visible. Ask which particles can give up electrons, which can take them, and how the resulting charged particles fit together. That approach connects an observation to a testable account of the reaction.

2. Magnesium sits in group 2 of the periodic table and has two electrons in its outermost occupied shell. It can lose both, forming Mg^{2+}. In the acid, each hydrogen ion, H^+, gains an electron. Two hydrogen ions are needed to accept the two electrons released by one magnesium atom. The resulting hydrogen atoms join in pairs to form H_2 gas. Chloride ions, Cl^-, stay in the liquid; two balance the charge of one Mg^{2+}, giving the formula $MgCl_2$. This charge balance explains why chlorine is part of the dissolved product rather than the bubbles.

3. Now revise the student's first claim: chlorine in an acid does not mean chlorine gas must appear. Electron transfer predicts hydrogen gas, while charge balance predicts dissolved magnesium chloride. The periodic table also helps extend the explanation. Calcium is below magnesium in group 2, so it also has two outer electrons and can form an ion with a two-positive charge. Its outer electrons are farther from the nucleus and generally easier to remove, so calcium tends to react more readily with dilute hydrochloric acid. That prediction uses a group pattern, not just the appearance of one fizzing strip.

2 ANSWER WITH EVIDENCE

Use the passage

1. How does the transfer of magnesium's outer electrons explain why one magnesium atom can produce one molecule of H_2?

2. Why is the dissolved compound $MgCl_2$ rather than MgCl? Use ion charges in your explanation.

3. Under similar conditions, predict whether calcium reacts more or less readily with dilute hydrochloric acid than magnesium. Explain using their periodic-table positions.

4. Revise the student's claim that the bubbles are chlorine gas. Explain what happens to the hydrogen and chloride from the acid.

3 YOUR TURN

Your own words

A student says sodium reacts with water by gaining an electron and that the bubbles are oxygen. Sodium has one outer electron and lies below lithium in group 1; hydrogen from water can form H_2, leaving OH^- ions. In four sentences, revise both claims, identify the dissolved ionic compound, and predict whether sodium or lithium reacts more readily with water using a periodic trend.

Follow the Electrons

PART 1 · READ AND MARK

Underline observations, circle clues about outer electrons or periodic trends, and number the steps that connect electron transfer to the products. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	How does the transfer of magnesium's outer electrons explain why one magnesium atom can produce one molecule of H_2?	**Magnesium loses two outer electrons. Two H^+ ions each gain one electron, and the resulting hydrogen atoms combine to form one H_2 molecule.**
2	Why is the dissolved compound $MgCl_2$ rather than MgCl? Use ion charges in your explanation.	**One Mg^{2+} ion needs two Cl^- ions to balance its charge, giving $MgCl_2$.**
3	Under similar conditions, predict whether calcium reacts more or less readily with dilute hydrochloric acid than magnesium. Explain using their periodic-table positions.	**Calcium tends to react more readily. It is below magnesium in group 2, where outer electrons are farther from the nucleus and generally easier to remove.**
4	Revise the student's claim that the bubbles are chlorine gas. Explain what happens to the hydrogen and chloride from the acid.	**The bubbles are H_2 gas: hydrogen ions gain electrons and form hydrogen molecules. Chloride ions remain in the liquid as part of dissolved $MgCl_2$.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

Sodium loses its one outer electron instead of gaining one, forming Na^+. Hydrogen from water forms H_2 gas, not oxygen gas. Na^+ and OH^- combine in a one-to-one ratio to make dissolved sodium hydroxide, NaOH. Sodium should react more readily than lithium because its outer electron is farther from the nucleus and easier to remove.

Accept explanations that correctly connect electron loss to the group trend and identify H_2 and NaOH as products. Relative reactivity assumes similar reaction conditions.