The Missing Labels

Use atomic structure to predict how elements behave.

PS.4.b "Predict the properties of an element based on the element's number of protons and valence electrons."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline each proton count, circle each valence electron count, and number the rules that help you predict whether an atom will lose, gain, or keep electrons.

A Chemical Inventory Mystery

1 At a recycling plant, a technician finds several containers whose labels have washed away. Element identity cannot be guessed from color alone. The number of protons in an atom's nucleus, called its atomic number, identifies the element. Neutral atoms have the same number of electrons as protons. The electrons in the outermost occupied energy level are called valence electrons. For many main-group elements, their number helps predict whether an atom tends to lose, gain, or share electrons. These changes affect properties such as reactivity and the kinds of ions the element can form.

2 The inventory names seven possible elements. A lithium atom has 3 protons and 1 valence electron. A sodium atom has 11 protons and 1 valence electron. A magnesium atom has 12 protons and 2 valence electrons. A neon atom has 10 protons and 8 valence electrons. A chlorine atom has 17 protons and 7 valence electrons. An argon atom has 18 protons and 8 valence electrons. A potassium atom has 19 protons and 1 valence electron. These counts describe neutral atoms, not ions. The inventory provides no test results, so the technician must make predictions from atomic structure.

3 Patterns in the main groups make those predictions possible. Atoms with one valence electron often lose it and form a singly charged positive ion. Atoms with two often lose both and form a doubly charged positive ion. Atoms with seven often gain one electron and form a singly charged negative ion. Atoms with eight already have a full outer energy level, so they are usually much less reactive. An atom's proton count stays the same when it becomes an ion. These patterns predict likely behavior, but they do not replace observations of a substance under specific conditions.

2 ANSWER WITH EVIDENCE

Use the passage

1. A neutral atom from the inventory has 3 protons. Identify the element and predict the ion it is likely to form.

2. A neutral atom has 12 protons. Identify the element and predict its ion. Explain the electron change.

3. A neutral atom has 17 protons. Identify the element and predict its ion using its valence electron count.

4. Compare the atoms with 10 and 11 protons. Which is likely to be less reactive? Use their valence electron counts to explain.

3 YOUR TURN

Your own words

The technician must choose between potassium and argon for a container that should resist chemical reactions. In three or four sentences, identify the better choice, use both proton and valence electron counts as evidence, and predict what ion each element is likely to form or explain why an ion is unlikely.

The Missing Labels

PART 1 · READ AND MARK

Underline each proton count, circle each valence electron count, and number the rules that help you predict whether an atom will lose, gain, or keep electrons. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	A neutral atom from the inventory has 3 protons. Identify the element and predict the ion it is likely to form.	**It is lithium, which is likely to lose one electron and form Li^+.**
2	A neutral atom has 12 protons. Identify the element and predict its ion. Explain the electron change.	**It is magnesium. It is likely to lose two electrons and form Mg^{2+}.**
3	A neutral atom has 17 protons. Identify the element and predict its ion using its valence electron count.	**It is chlorine. With 7 valence electrons, it is likely to gain one electron and form Cl^-.**
4	Compare the atoms with 10 and 11 protons. Which is likely to be less reactive? Use their valence electron counts to explain.	**Neon, with 10 protons, is likely to be less reactive. It has 8 valence electrons and a full outer energy level, while sodium, with 11 protons, has 1 valence electron that it can lose.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

Argon is the better choice: its 18 protons identify it, and its 8 valence electrons make it usually much less reactive. Argon is unlikely to form an ion because its outer energy level is full. Potassium has 19 protons and 1 valence electron, so it is more likely to react by losing that electron. Potassium would then form K^+.

Accept equivalent explanations that connect proton count to element identity and valence electron count to likely electron change. Predictions describe general tendencies, not guaranteed behavior under every condition.