

Outer Electron Detectives

Use periodic patterns to predict ions, formulas, bonds, and reactivity.

HIGH SCHOOL · HS-PS1-1

HS-PS1-1 "Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms..."

NAME _____

DATE _____

OUTER ELECTRONS GUIDE PROPERTIES

An element's main-group column tells you how many electrons are in its outermost energy level. Metals usually lose outer electrons, nonmetals usually gain or share them, and ionic formulas must have a total charge of zero. For metals in the same group, reactivity usually increases as you move down the group.

WORKED EXAMPLE

Predict the formula of the ionic compound formed by barium and phosphorus.

1. Barium is in group 2, so it forms Ba^{2+} .
2. Phosphorus is in group 15, so it forms P^{3-} .
3. Three Ba^{2+} ions give +6, and two P^{3-} ions give -6.
4. Write the neutral formula as Ba_3P_2 .

Answer: Ba_3P_2

PRACTICE 6 problems

- 1** How many valence electrons does bromine have? What ion does it usually form?

ANSWER _____

- 2** Predict the formula of the ionic compound made from strontium and iodine.

ANSWER _____

- 3** Predict the formula of the ionic compound made from sodium and sulfur.

ANSWER _____

- 4** Carbon is in group 14. How many covalent bonds does a carbon atom usually form in simple molecules?

ANSWER _____

- 5** Which metal is more reactive, lithium or rubidium? Use their positions in group 1 to decide.

ANSWER _____

- 6** Predict the formula of the compound formed when aluminum reacts with oxygen.

ANSWER _____

APPLY IT Show your work

- 1** A sports drink company is considering potassium chloride as a source of potassium. Use the periodic table to predict the formula of this ionic compound.

WORK SPACE

ANSWER _____

- 2** Phone screens contain glass made with silicon dioxide. Based on their main-group positions, predict how many covalent bonds silicon and oxygen typically form, then write the empirical formula of silicon dioxide.

WORK SPACE

ANSWER _____

CHALLENGE One step up

CHALLENGE

Elements A, B, and C are main-group elements. A is a metal with 2 valence electrons, B is a nonmetal with 6 valence electrons, and C is a nonmetal with 7 valence electrons. Which compound has fewer total atoms in one formula unit, AB or AC? Write both formulas and explain your reasoning.

PART 1 • PRACTICE

#	PROBLEM	ANSWER
1	How many valence electrons does bromine have? What ion does it usually form?	7 valence electrons; Br-
2	Predict the formula of the ionic compound made from strontium and iodine.	SrI₂
3	Predict the formula of the ionic compound made from sodium and sulfur.	Na₂S
4	Carbon is in group 14. How many covalent bonds does a carbon atom usually form in simple molecules?	4 covalent bonds
5	Which metal is more reactive, lithium or rubidium? Use their positions in group 1 to decide.	Rubidium is more reactive because it is lower in group 1.
6	Predict the formula of the compound formed when aluminum reacts with oxygen.	Al₂O₃

PART 2 • APPLY IT

1. **KCl** Potassium forms K⁺ and chlorine forms Cl⁻. One ion of each gives a total charge of zero.
2. **Silicon forms 4 covalent bonds, oxygen forms 2 covalent bonds, and the empirical formula is SiO₂.** Silicon has 4 valence electrons and typically forms 4 bonds. Oxygen has 6 valence electrons and typically forms 2 bonds, giving a 1:2 silicon-to-oxygen ratio.

CHALLENGE

AB has fewer total atoms. A forms A²⁺, B forms B²⁻, so AB has 2 total atoms. C forms C⁻, so AC₂ has 3 total atoms.

Accept correct charge-balancing explanations and formulas with proper element order and subscripts. For the challenge, accept an explanation that identifies the 2⁺ and 2⁻ balance in AB and the need for two C⁻ ions in AC₂.