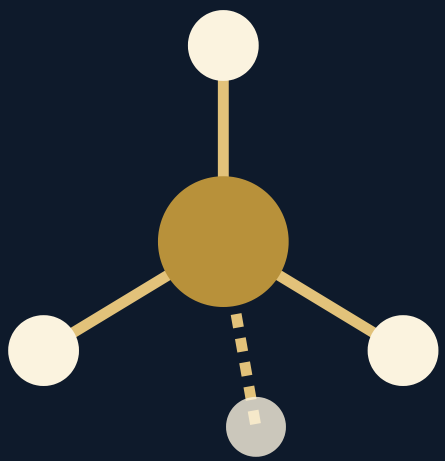
KECUDO

HIGH SCHOOL CHEMISTRY

Chemical Bonding

Class 2 · Concepts, Labs & Structures



PREMIUM
II
EDITION

2026 EDITION · STUDENT SERIES

About this book

Welcome to **High School Chemistry, Class 2: Chemical Bonding & Molecular Structure**. In Class 1 you met atoms one at a time; now you will see how they join, what shapes they make, and why those shapes decide how every substance behaves.

How each chapter works

- **Depth dots** show the level: Foundation ●○○, Core ●●○, Advanced ●●●.
- **Concepts** with worked examples and figures drawn from real data.
- **Kecudo Lab** boxes: one hands-on experiment per chapter.
- **Try it** questions with answers, plus a 25-question scored self-assessment at the end.

Our running example

Kecudo Chem Co. is back with “Sample K” — now identified as copper. You will see why copper conducts (metallic bonding), name its compounds such as copper(II) sulfate, and grow its blue ionic crystals. Kecudo Salt Co. and Kecudo Water Co. return too.

Data sources

Pauling electronegativity scale; average bond enthalpies and lengths from the CRC Handbook of Chemistry and Physics; boiling and melting points from the CRC Handbook and NIST Chemistry WebBook. Kecudo company names and Sample K are fictional teaching examples.

> **Safety & use.** Educational content only. Perform experiments only with a qualified teacher, proper safety equipment and your school's safety rules. Steps marked “teacher demonstration” or “teacher-supervised” are not for students alone.

© 2026 Kecudo. All rights reserved. For personal use only; please do not redistribute. kecudo.com

Contents

Part I · Foundations

1 Why Atoms Bond 4

2 Ions & Ionic Bonding 6

3 Writing Ionic Formulas 8

4 Covalent Bonding 11

5 Metallic Bonding 13

Part II · Core

6 Drawing Lewis Structures 15

7 Resonance & Exceptions 17

8 Electronegativity & Bond Polarity 19

9 VSEPR: The Shapes of Molecules 21

Part III · Advanced

10 Molecular Polarity 23

11 Intermolecular Forces 25

12 Properties from Structure 27

13 Naming Compounds 29

Self-assessment

★ 25-question quiz · Parts A–E 31

★ Your final rating 36

●○○ FOUNDATION

Chapter 1

Why Atoms Bond

A **chemical bond** is an attraction that holds atoms together. Atoms bond because the bonded arrangement has **lower energy** — and lower energy means more stable.

Valence electrons decide everything

Only the outermost (**valence**) electrons take part in bonding. For main-group elements, the group number tells you how many there are.

Group	1	2	13	14	15	16	17	18
Valence e^-	1	2	3	4	5	6	7	8

Lewis symbols show valence electrons as dots around the element symbol (draw one dot per side before pairing).

The octet rule

Atoms tend to gain, lose or share electrons until they have **eight valence electrons** — the stable arrangement of a noble gas. Hydrogen and helium are happy with two (a “duet”).

> **Three ways to reach an octet:** *transfer* electrons (ionic bond, metal + nonmetal) · *share* electrons (covalent bond, nonmetal + nonmetal) · *pool* electrons (metallic bond, metal + metal).

Energy and bonding

When two hydrogen atoms approach, the energy falls as each nucleus attracts the other atom's electron — until the nuclei get too close and repel. The lowest point is the **bond length** (74 pm for H_2); the depth of the dip is the **bond energy** (436 kJ/mol).

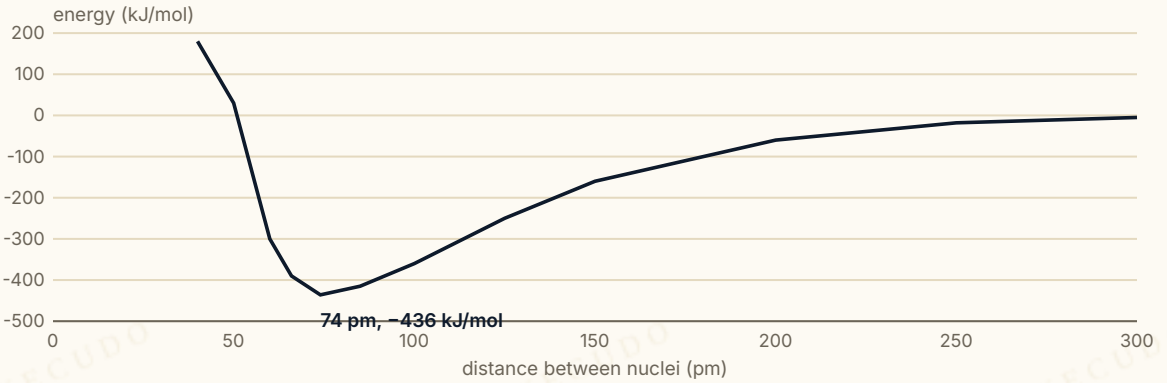


FIG 1.1 · Energy of two hydrogen atoms vs. distance (schematic, with real minimum)

Source: Bond length and enthalpy of H_2: CRC Handbook. Curve shape is illustrative.

Making a bond always releases energy; **breaking** a bond always takes energy. You will use this in Class 5 to explain why reactions get hot or cold.

⚗ Kecudo Lab · Dot-and-Cross Cards

Make cards for H, C, N, O, Na, Mg and Cl with the correct number of valence dots. Pair cards so every atom reaches an octet (or duet for H). Record which pairs transferred and which shared electrons.

✎ Try it

1. How many valence electrons does sulfur (group 16) have?
2. Which atoms follow a “duet” rule?
3. Does breaking a bond release or absorb energy?

Answers: **1.** 6 · **2.** H and He · **3.** absorbs

FOUNDATION

Chapter 2

Ions & Ionic Bonding

An **ionic bond** is the electrostatic attraction between oppositely charged ions. It forms when a metal **transfers** electrons to a nonmetal.

$$Na\cdot + \cdot\ddot{Cl}: \rightarrow Na^+ \; [:\ddot{Cl}:]^-$$

Sodium loses its one valence electron (leaving the neon arrangement); chlorine gains it (reaching the argon arrangement). Opposite charges attract strongly in every direction.

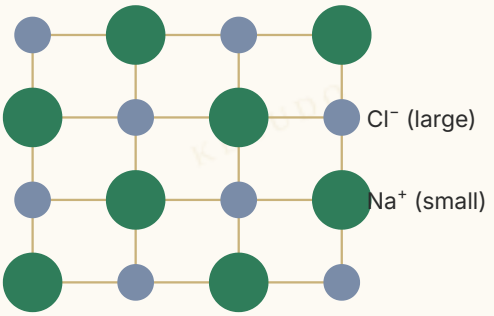


FIG 2.1 · One layer of the NaCl crystal lattice

There are no separate “NaCl molecules”. Ions stack in a repeating 3-D **crystal lattice**; the formula shows only the 1 : 1 ratio, called a **formula unit**.

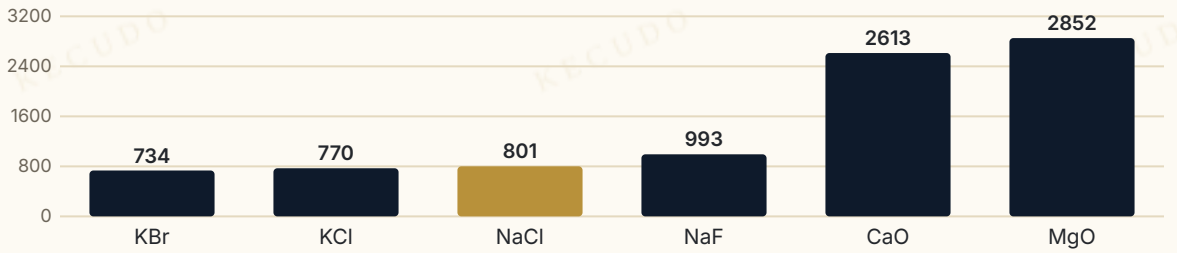


FIG 2.2 · Melting points of ionic compounds (°C)

Source: CRC Handbook.

●○○ FOUNDATION

Chapter 3

Writing Ionic Formulas

An ionic compound is always **electrically neutral**: total positive charge equals total negative charge. That one rule lets you write any ionic formula.

The criss-cross method

Write both ions with charges › Cross the numbers (not signs) › Reduce to lowest ratio › Check: charges sum to 0

Ions	Criss-cross	Formula	Check
$Ca^{2+} + Cl^{-}$	Ca_1Cl_2	$CaCl_2$	+2 − 2 = 0
$Al^{3+} + O^{2-}$	Al_2O_3	Al_2O_3	+6 − 6 = 0
$Mg^{2+} + O^{2-}$	Mg_2O_2	MgO (reduced)	+2 − 2 = 0
$Na^{+} + S^{2-}$	Na_2S_1	Na_2S	+2 − 2 = 0

Polyatomic ions

Some ions are groups of covalently bonded atoms that carry an overall charge. Keep them together and use brackets when you need more than one.

Ion	Name	Ion	Name
NH_4^{+}	ammonium	NO_3^{-}	nitrate
OH^{-}	hydroxide	SO_4^{2-}	sulfate
HCO_3^{-}	hydrogen carbonate	CO_3^{2-}	carbonate
$C_2H_3O_2^{-}$	acetate	PO_4^{3-}	phosphate

SELF-ASSESSMENT

Part A · Basics

Choose one answer per question. Your choice locks, and your score updates at the top of the screen.

A1. An ionic bond forms between...

- A. Two nonmetals
- B. A metal and a nonmetal
- C. Two noble gases
- D. Two metals

A2. A covalent bond is a...

- A. Transferred electron
- B. Sea of electrons
- C. Shared pair of electrons
- D. Proton exchange

A3. How many valence electrons does nitrogen have?

- A. 5
- B. 3
- C. 7
- D. 2

A4. Which property is explained by the electron sea in metals?

- A. Brittleness
- B. Low melting point
- C. Not conducting
- D. Conducting electricity

A5. The shape of a methane (CH_4) molecule is...

- A. Linear
- B. Bent
- C. Tetrahedral
- D. Trigonal planar

KECUDO



KECUDO

Thank you for learning with Kecudo.

Next in the series

Class 3 — The Mole & Chemical Reactions

Counting atoms by weighing · balancing equations · reaction types · stoichiometry & limiting reactants

© 2026 Kecudo · kecudo.com