

Writing Chemical Formulae

Name: _____ Class: _____ Date: _____



Game 1: Ions Matchmaker
edtechsims.com/ions-matchmaker



Game 2: Formula Writing Challenge
edtechsims.com/formula-writing-challenge



Game 3: Formula Feast
edtechsims.com/formula-feast

Part A: Ions

Game 1: Play Ions Matchmaker to learn the names, formulae and charges of common ions. Then complete Part A.

Game 1 score: _____ / _____

A1 Main Group Ions

- Atoms of metals usually _____ valence electrons to attain the electronic configuration of a noble gas, thereby forming _____ ions known as _____.
- For positive ions of elements in Groups 1, 2 and 13, the numerical charge of the ion is the same as the last digit of the _____.
- For a monatomic positive ion, its name is the _____ as that of the atom.
- Atoms of non-metals usually _____ valence electrons to attain the electronic configuration of a noble gas, thereby forming _____ ions known as _____.
- For a monatomic negative ion, its name usually ends in _____.

ION NAME	FORMULA	ION NAME	FORMULA
Lithium		Nitride	
Sodium			P^{3-}
	K^+	Sulfide	
Beryllium		Oxide	
Magnesium			F^-
	Ca^{2+}	Chloride	
Barium		Bromide	
Aluminium			I^-
	H^+	Hydride	H^-

Note: Hydrogen can form both positive and negative ions.

A2 Ions of d-block Elements and Lead

- Many d-block elements can form ions of different charges, so the charge is shown using Roman numerals in round brackets after the name, e.g. iron(III).
- Some d-block elements, such as _____ and _____, only form ions of a fixed charge.
- Some main group elements, such as _____, can form ions of different charges.

ION NAME	FORMULA	ION NAME	FORMULA
Copper(I)			Fe^{2+}
Copper(II)			Fe^{3+}
	Zn^{2+}		Ag^+
Lead(II)		Lead(IV)	

A3 Polyatomic Ions

- Polyatomic ions are formed when two or more _____-bonded atoms, acting as a single unit, gain or lose electrons.
- Polyatomic ions containing oxygen atoms usually have names ending in _____ or _____, except _____, which ends in -ide.

ION NAME	FORMULA	ION NAME	FORMULA
Hydroxide		Carbonate	
Nitrate		Sulfate	

Part B: Ionic Compounds

Game 2: Play the Formula Writing Challenge. Then complete Part B.

Game 2 score: _____ / _____

- The sum of _____ charges and the sum of _____ charges must be _____, so that the compound formed is electrically neutral.
- The metal (positive ion) is written first, and the name of the non-metal ion comes second.
- A round bracket is used to show more than one polyatomic ion, e.g. magnesium nitrate is $\text{Mg}(\text{NO}_3)_2$. No bracket is needed for one polyatomic ion, e.g. NaNO_3 .

Worked examples

Ions	Formula of compound	Name of compound
K^+ and Br^-	KBr	potassium bromide
Al^{3+} and O^{2-}	Al_2O_3	aluminium oxide
Ca^{2+} and OH^-	$\text{Ca}(\text{OH})_2$	calcium hydroxide

B1 Main Group Elements Only

NAME	FORMULA	NAME	FORMULA
sodium chloride		barium bromide	
magnesium fluoride		lithium sulfide	
aluminium oxide		calcium nitride	
potassium oxide			AlCl_3

B2 d-block Elements and Lead

NAME	FORMULA	NAME	FORMULA
	FeCl_3	copper(II) oxide	
iron(II) bromide			CuI
	PbBr_2		PbF_4
	ZnF_2	silver sulfide	

B3 Polyatomic Ions

NAME	FORMULA	NAME	FORMULA
aluminium nitrate		zinc nitrate	
zinc carbonate		iron(II) sulfate	
sodium nitrate		potassium sulfate	
copper(II) nitrate		silver carbonate	
lead(II) carbonate		magnesium sulfate	
calcium hydroxide			Fe(OH) ₃

Part C: Covalent Substances

- Many non-metal elements exist as diatomic molecules, e.g. H₂, N₂, O₂, F₂, Cl₂, Br₂, I₂.
- Some compounds are always called by their common names, e.g. water (H₂O), ammonia (NH₃), methane (CH₄).
- Prefixes such as mono-, di-, tri-, tetra- and penta- show the number of atoms of each element. Mono- is only used when needed, e.g. carbon monoxide (CO).

NAME	FORMULA	NAME	FORMULA
hydrogen		oxygen	
nitrogen		chlorine	
water		ammonia	
methane		carbon monoxide	
carbon dioxide		sulfur dioxide	
sulfur trioxide			NO ₂
	CCl ₄		P ₂ O ₅

Part D: Mixed Challenge

Game 3: Play Formula Feast. Then complete Part D.

Game 3 score: _____ / _____

D1 Name ↔ Formula

NAME	FORMULA	NAME	FORMULA
sodium carbonate		zinc hydroxide	
iron(II) nitrate			AgNO ₃
aluminium sulfate			Ca ₃ P ₂
	PbO	barium sulfate	
copper(I) oxide			Mg ₃ N ₂

D2 Spot the Mistake

Each formula below is wrong. Write the correct formula and explain the mistake.

Compound	Wrong formula	Correct formula	What is the mistake?
Magnesium chloride	MgCl		
Sodium oxide	NaO ₂		
Calcium hydroxide	CaOH ₂		
Aluminium sulfate	Al ₂ SO ₄₃		
Copper(II) nitrate	CuNO ₃		
Iron(III) chloride	Fe ₃ Cl		

Answer Key: Writing Chemical Formulae

Answers that students write are shown in blue in the tables.

Part A: Ions

Game 1: Play Ions Matchmaker to learn the names, formulae and charges of common ions. Then complete Part A.

A1 Main Group Ions

- Atoms of metals usually **lose** valence electrons to attain the electronic configuration of a noble gas, thereby forming **positive** ions known as **cations**.
- For positive ions of elements in Groups 1, 2 and 13, the numerical charge of the ion is the same as the last digit of the **group number**.
- For a monatomic positive ion, its name is the **same** as that of the atom.
- Atoms of non-metals usually **gain** valence electrons to attain the electronic configuration of a noble gas, thereby forming **negative** ions known as **anions**.
- For a monatomic negative ion, its name usually ends in **-ide**.

ION NAME	FORMULA	ION NAME	FORMULA
Lithium	Li ⁺	Nitride	N ³⁻
Sodium	Na ⁺	Phosphide	P ³⁻
Potassium	K ⁺	Sulfide	S ²⁻
Beryllium	Be ²⁺	Oxide	O ²⁻
Magnesium	Mg ²⁺	Fluoride	F ⁻
Calcium	Ca ²⁺	Chloride	Cl ⁻
Barium	Ba ²⁺	Bromide	Br ⁻
Aluminium	Al ³⁺	Iodide	I ⁻
Hydrogen	H ⁺	Hydride	H ⁻

Note: Hydrogen can form both positive and negative ions.

A2 Ions of d-block Elements and Lead

- Many d-block elements can form ions of different charges, so the charge is shown using Roman numerals in round brackets after the name, e.g. iron(III).
- Some d-block elements, such as **zinc** and **silver**, only form ions of a fixed charge.
- Some main group elements, such as **lead**, can form ions of different charges.

ION NAME	FORMULA	ION NAME	FORMULA
Copper(I)	Cu^+	Iron(II)	Fe^{2+}
Copper(II)	Cu^{2+}	Iron(III)	Fe^{3+}
Zinc	Zn^{2+}	Silver	Ag^+
Lead(II)	Pb^{2+}	Lead(IV)	Pb^{4+}

A3 Polyatomic Ions

- Polyatomic ions are formed when two or more **covalently**-bonded atoms, acting as a single unit, gain or lose electrons.
- Polyatomic ions containing oxygen atoms usually have names ending in **-ate** or **-ite**, except **hydroxide**, which ends in **-ide**.

ION NAME	FORMULA	ION NAME	FORMULA
Hydroxide	OH^-	Carbonate	CO_3^{2-}
Nitrate	NO_3^-	Sulfate	SO_4^{2-}

Part B: Ionic Compounds

Game 2: Play the Formula Writing Challenge. Then complete Part B.

- The sum of **positive** charges and the sum of **negative** charges must be **equal**, so that the compound formed is electrically neutral.
- The metal (positive ion) is written first, and the name of the non-metal ion comes second.
- A round bracket is used to show more than one polyatomic ion, e.g. magnesium nitrate is $\text{Mg}(\text{NO}_3)_2$. No bracket is needed for one polyatomic ion, e.g. NaNO_3 .

Worked examples

Ions	Formula of compound	Name of compound
K^+ and Br^-	KBr	potassium bromide
Al^{3+} and O^{2-}	Al_2O_3	aluminium oxide
Ca^{2+} and OH^-	$\text{Ca}(\text{OH})_2$	calcium hydroxide

B1 Main Group Elements Only

NAME	FORMULA	NAME	FORMULA
sodium chloride	NaCl	barium bromide	BaBr₂
magnesium fluoride	MgF₂	lithium sulfide	Li₂S
aluminium oxide	Al₂O₃	calcium nitride	Ca₃N₂
potassium oxide	K₂O	aluminium chloride	AlCl_3

B2 d-block Elements and Lead

NAME	FORMULA	NAME	FORMULA
iron(III) chloride	FeCl_3	copper(II) oxide	CuO
iron(II) bromide	FeBr₂	copper(I) iodide	CuI
lead(II) bromide	PbBr_2	lead(IV) fluoride	PbF_4
zinc fluoride	ZnF_2	silver sulfide	Ag₂S

B3 Polyatomic Ions

NAME	FORMULA	NAME	FORMULA
aluminium nitrate	$\text{Al}(\text{NO}_3)_3$	zinc nitrate	$\text{Zn}(\text{NO}_3)_2$
zinc carbonate	ZnCO_3	iron(II) sulfate	FeSO_4
sodium nitrate	NaNO_3	potassium sulfate	K_2SO_4
copper(II) nitrate	$\text{Cu}(\text{NO}_3)_2$	silver carbonate	Ag_2CO_3
lead(II) carbonate	PbCO_3	magnesium sulfate	MgSO_4
calcium hydroxide	$\text{Ca}(\text{OH})_2$	iron(III) hydroxide	$\text{Fe}(\text{OH})_3$

Part C: Covalent Substances

- Many non-metal elements exist as diatomic molecules, e.g. H_2 , N_2 , O_2 , F_2 , Cl_2 , Br_2 , I_2 .
- Some compounds are always called by their common names, e.g. water (H_2O), ammonia (NH_3), methane (CH_4).
- Prefixes such as mono-, di-, tri-, tetra- and penta- show the number of atoms of each element. Mono- is only used when needed, e.g. carbon monoxide (CO).

NAME	FORMULA	NAME	FORMULA
hydrogen	H_2	oxygen	O_2
nitrogen	N_2	chlorine	Cl_2
water	H_2O	ammonia	NH_3
methane	CH_4	carbon monoxide	CO
carbon dioxide	CO_2	sulfur dioxide	SO_2
sulfur trioxide	SO_3	nitrogen dioxide	NO_2
carbon tetrachloride	CCl_4	diphosphorus pentoxide	P_2O_5

Part D: Mixed Challenge

Game 3: Play Formula Feast. Then complete Part D.

D1 Name ↔ Formula

NAME	FORMULA	NAME	FORMULA
sodium carbonate	Na_2CO_3	zinc hydroxide	$\text{Zn}(\text{OH})_2$
iron(II) nitrate	$\text{Fe}(\text{NO}_3)_2$	silver nitrate	AgNO_3
aluminium sulfate	$\text{Al}_2(\text{SO}_4)_3$	calcium phosphide	Ca_3P_2
lead(II) oxide	PbO	barium sulfate	BaSO_4
copper(I) oxide	Cu_2O	magnesium nitride	Mg_3N_2

D2 Spot the Mistake

Each formula below is wrong. Write the correct formula and explain the mistake.

Compound	Wrong formula	Correct formula	What is the mistake?
Magnesium chloride	MgCl	MgCl_2	Charges not balanced: Mg^{2+} needs two Cl^- .
Sodium oxide	NaO_2	Na_2O	Subscript on the wrong element: two Na^+ balance one O^{2-} .
Calcium hydroxide	CaOH_2	$\text{Ca}(\text{OH})_2$	Missing brackets around the polyatomic ion OH^- .
Aluminium sulfate	$\text{Al}_2\text{SO}_{43}$	$\text{Al}_2(\text{SO}_4)_3$	Missing brackets around SO_4^{2-} .
Copper(II) nitrate	CuNO_3	$\text{Cu}(\text{NO}_3)_2$	Charges not balanced, and brackets needed for two NO_3^- .
Iron(III) chloride	Fe_3Cl	FeCl_3	Subscripts swapped: one Fe^{3+} needs three Cl^- .