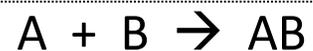


Writing Chemical Reactions

Combination Reactions

Two single atoms yield a single ionic / covalent structure



A = Metal (+ ion) or Non-Metal (covalent)

B = Non-Metal (- ion) or Polyatomic Ion (- ion)

AB = Ionic Compound or Covalent Molecule

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Writing Chemical Reactions

Metal and Non-Metal Ion Charges

The charge of metals are based on the periodic table

Representative Elements (Metals and Non-Metals)

Group	1A	2A	1B-10B	3A	4A	5A	6A	7A	8A
	1	2	3-12	13	14	15	16	17	18
Ion Charge	+1	+2	Var (+)	+3	+4/-4	-3	-2	-1	0

Transition Metals [Group 1B – 10B (3 - 12)] have variable charges based on the metals Lewis Dot Structures

3

Writing Chemical Reactions

Polyatomic Ions Chart (Formulas and Ion Charges)

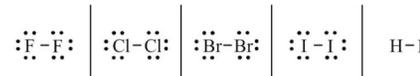
Polyatomic Ion	Ion Formula	Polyatomic Ion	Ion Formula	Polyatomic Ion	Ion Formula
Ammonium	NH ₄ ⁺	Hydronium	H ₃ O ⁺	Carbonate	CO ₃ ²⁻
Nitrate	NO ₃ ¹⁻	Cyanide	CN ¹⁻	Sulfate	SO ₄ ²⁻
Fluorate	FO ₃ ¹⁻	Hydroxide	OH ¹⁻	Chromate	CrO ₄ ²⁻
Chlorate	ClO ₃ ¹⁻	Acetate	C ₂ H ₃ O ₂ ¹⁻	Dichromate	Cr ₂ O ₇ ²⁻
Bromate	BrO ₃ ¹⁻	Permanganate	MnO ₄ ¹⁻	Oxalate	C ₂ O ₄ ²⁻
Iodate	IO ₃ ¹⁻	Bicarbonate	HCO ₃ ¹⁻	Phosphate	PO ₄ ³⁻

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Writing Chemical Reactions

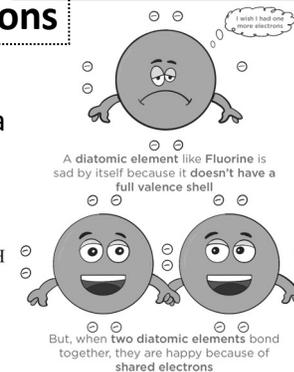
Diatomic Elements

Elements that always appear as a pair of neutral atoms (X₂) in a chemical reaction.



Diatomic Elements

H₂, N₂, O₂, F₂, Cl₂, Br₂, I₂



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Writing Chemical Reactions

Decomposition Reactions

An ionic compound or molecule decomposes into two separate atoms / ions in the products



AB = Ionic Compound or Covalent Molecule

A = Single Metal/Non-Metal/Ion (+)

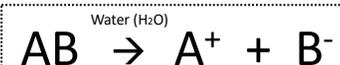
B = Single Non-Metal/Ion (-)

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Writing Chemical Reactions

Ionization of Ionic Compounds

Ionization occurs when an ionic compound decomposes into ions in an aqueous (*water based*) mixture (*solution*)



ionization generally occurs during a chemical reaction process (*single or double replacement*) or as part of an aqueous (*water based*) homogenous mixture (*solution*)

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Writing Chemical Reactions

Single Replacement Reactions

An ionic compound dissociates in water then reacts with a single metal atom with a *higher activity*.



A = Metal (*More Active*) B = Metal (*Less Active*)

BC = Ionic Compound AC = Ionic Compound

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Activity Series

A Series of Elements that can replace other elements in a single replacement reaction

Elements lower than H can not react with *acids*, while only a metal higher than another can *replace* it in a single replacement reaction

Metals	Reactivity
Potassium	Reacts with water
Sodium	
Lithium	
Barium	
Strontium	
Calcium	
Magnesium	
Aluminium	
Manganese	
Zinc	
Chromium	Reacts with acids
Iron	
Cadmium	
Cobalt	
Nickel	
Tin	
Lead	
Hydrogen	
Antimony	
Bismuth	
Copper	Included for comparison
Mercury	
Silver	
Gold	
Platinum	
	Highly unreactive

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Writing Chemical Reactions

Double Replacement Reactions

Two ionic compound dissociates in water then their ions react to produce a solid/water/gas and dissolved ions



A = Metal

C = Metal (*Less Active*)

B = Non-Metal/Poly Ion

D = Non-Metal/Poly Ion

AD or CB must be a solid (ppt), liquid (H₂O) or a gas

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Writing Chemical Reactions

Acid Base Neutralization Reactions

An **Acid** (HX, produces H⁺ ion) reacts with a **Base** (YOH, produces OH⁻ ions) to produce **water** and a **salt** (ionic)



HX = Acid (HX)

C = Water (HOH, H₂O)

YOH = Base (YOH)

D = Ionic Salt (YX)

Acids (pH < 7) + Base (pH > 7) becomes Water (pH = 7)

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Products of Double Replace Reactions

Solids (s)

A **precipitate** is a solid produced from a chemical Reaction. A ppt will form via the chart shown to the right

**Solubility Table
Common Ionic Compounds**

	Group 1				Group 2			Transition Metals					
	NH ₄ ⁺	Li ⁺	Na ⁺	K ⁺	Mg ²⁺	Ca ²⁺	Ba ²⁺	Al ³⁺	Fe ²⁺	Cu ²⁺	Ag ⁺	Zn ²⁺	Pb ²⁺
F ⁻	sol	sol	sol	sol	insol	insol	sl sol	sol	sl sol	sol	sol	sol	insol
Cl ⁻	sol	sol	sol	sol	sol	sol	sol	sol	sol	sol	insol	sol	sol
Br ⁻	sol	sol	sol	sol	sol	sol	sol	sol	sol	sol	insol	sol	sl sol
I ⁻	sol	sol	sol	sol	sol	sol	sol	sol	sol	sol	insol	sol	sl sol
OH ⁻	sol	sol	sol	sol	sol	sl sol	sol	insol	insol	insol	insol	insol	insol
S ²⁻	sol	sol	sol	sol	sol	sl sol	sol	insol	insol	insol	insol	insol	insol
SO ₄ ²⁻	sol	sol	sol	sol	sol	sol	insol	sol	sol	sl sol	sol	sol	insol
CO ₃ ²⁻	sol	sol	sol	sol	insol	insol	insol			sl sol	insol	insol	insol
NO ₃ ⁻	sol	sol	sol	sol	sol	sol	sol	sol	sol	sol	sol	sol	sol
PO ₄ ³⁻	sol	insol	sol	sol	insol	insol	insol	insol	insol	insol	insol	insol	insol
CrO ₄ ²⁻	sol	sol	sol	sol	sol	sol	insol	insol	insol	insol	insol	insol	insol
CH ₃ CO ₂ ⁻	sol	sol	sol	sol	sol	sol	sol	sl sol	sol	sol	sol	sol	sol

sol — soluble >1g/100 mL
sl sol — slightly soluble (0.1 to 1) g/100 mL
insol — insoluble <0.1g/100 mL
(blank) — not enough solubility data available to be determined

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Products of Double Replace Reactions

Liquids (l)

A **pure liquid** from a chemical reaction is a liquid which matches the *solvent* (the liquid the reaction occurs in)
Most reactions occur in an aqueous (H₂O) solution

Gas (g)

A **gas** is a product produced by a *gas formation* reaction (CO, CO₂, NO₂, SO₂, O₂, N₂)

Solvent – Liquid Portion Reaction Occurs in
Solution – Combination of an ionic salt in solvent

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