

Grade 10 Science

Chemical Reactions

Class 1

Overall Expectations

- Analyse a variety of safety and environmental issues associated with chemical reactions, including the ways in which chemical reactions can be applied to address environmental challenges
- Investigate, through inquiry, the characteristics of chemical reactions
- Demonstrate an understanding of the general principles of chemical reactions, and various ways to represent them

Physical and Chemical Properties

- Physical Property – does not involve forming a new substance
 - Colour
 - Texture
 - Density
 - Smell
 - Melting Point
- Chemical Property – changes into one or more new substances
 - Flammability
 - Bleaching
 - Corrosion
 - Rusting



Checkpoint

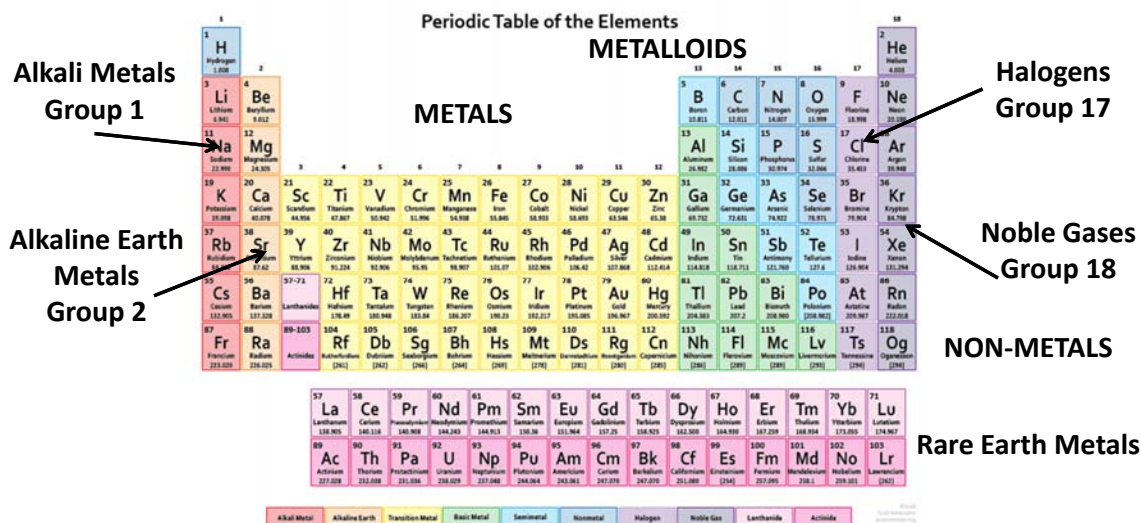


Classify the following as a physical or chemical property:

- a) Liquid nitrogen boils at -196°C
- b) Propane, leaking from a tank, ignites easily
- c) Silver jewelry tarnishes in air
- d) Spilled oil floats on the surface of water
- e) Meat darkens when it is heated on a grill
- f) Sulfur trioxide changes to sulfuric acid in the atmosphere

Patterns in the Periodic Table

- **Group/Family** – column in the periodic table
- **Period** – row in the periodic table



Atomic Structure

- An atom consists of:

	Proton	Neutron	Electron
Electrical Charge	+	0	-
Relative Mass	1	1	1/2000
Symbol	p ⁺	n ⁰	e ⁻
Location	Nucleus	Nucleus	Outside Nucleus

Mass Number/Atomic Number



- **Atomic number** = Protons OR Electrons (if neutral)
 - Ex: Helium has 2 protons and 2 electrons
- **Mass number** = Protons + Neutrons
 - Ex: Helium has 2 neutrons

Terms to Know

- **Isotope** – elements with the same number of protons but a different number of neutrons; different mass
 - Ex: Carbon-12 and Carbon-14
- **Ion** – elements with the same number of protons but a different number of electrons; different charge
 - Ex: Be and Be²⁺
 - **Cations** = ions with a positive charge
 - **Anions** = ions with a negative charge
 - **Note: Atoms become ions when there is a loss/gain of electrons NOT protons**



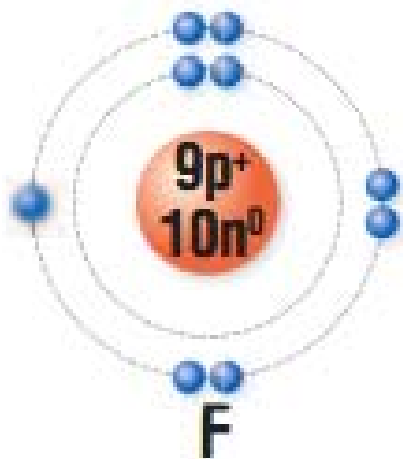
Checkpoint



List the number of p^+ , n^0 , and e^- for:

- a) Beryllium
- b) Phosphorus
- c) Neon
- d) Fluorine ion (F^-)

Bohr-Rutherford Diagrams



1. Draw the nucleus and write the number of protons and neutrons inside
2. Add the electrons to the outer shells
 - 1st = 2 electrons
 - 2nd = 8 electrons
 - 3rd = 8 electrons
 - 4th = 18 electrons



Checkpoint

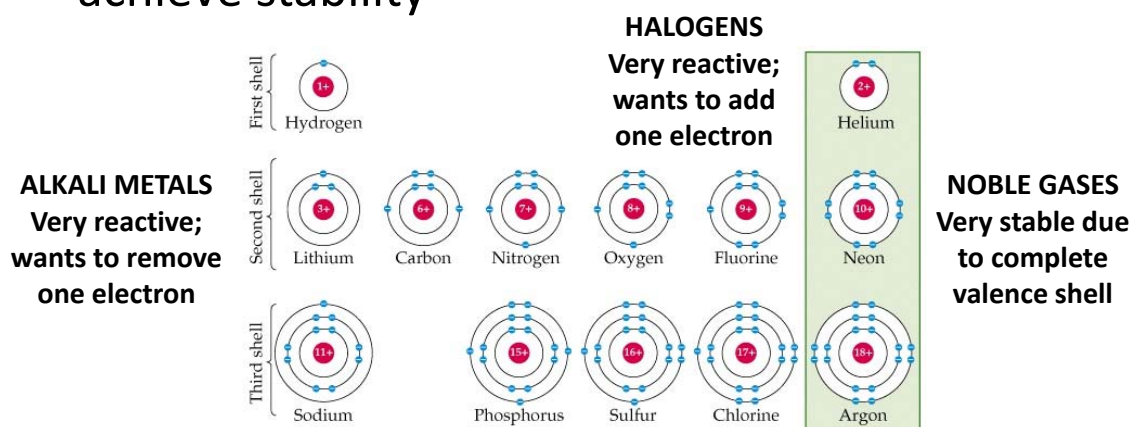


Draw the Bohr-Rutherford Diagrams for:

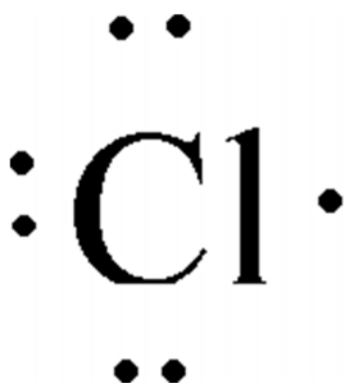
- a) Lithium-6 isotope
- b) Potassium ion (K^+)

Reactivity

- **Valence electrons** determine the reactivity of an element and how compounds are formed
- Elements lose or gain valence electrons to achieve stability



Lewis Dot Diagrams



1. Write the element symbol
2. Find the number of valence electrons by looking at the Roman Numeral above the element's group
3. Put dots representing the electrons on the four sides of the element singly before pairing up



Checkpoint

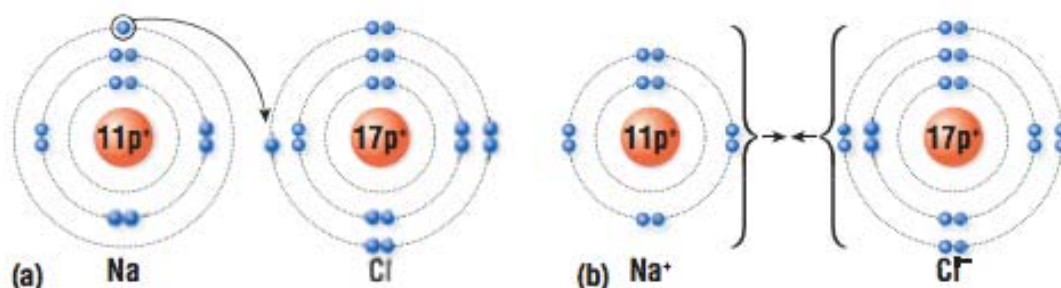


Draw the Lewis Dot Diagram of:

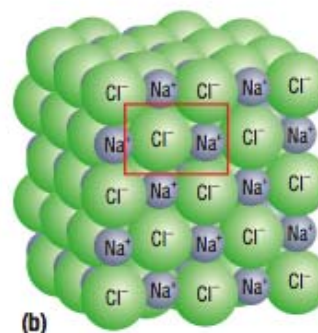
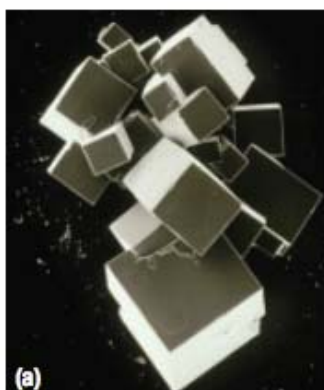
- a) Boron
- b) Silicon
- c) Argon
- d) Mg^{2+}
- e) O^{2-}

Ionic Compounds

- Ionic compound – formed between a metal and a non-metal; a cation and an anion
 - Metal loses electron(s)
 - Non-metal gains electron(s)



- Properties of Ionic Compounds:
 - Form Crystal-Like Structures
 - Hard, Brittle
 - High Melting Points
 - Electrolytes (dissolve in water to conduct electricity)



Chemical Formulas

What is the chemical formula for sodium chloride?

- 1) Write the element symbol (metal+nonmetal)
- 2) Look at the periodic table and find their ionic charge
- 3) Criss-cross the ionic charge
- 4) If subscripts have a common factor, they should be simplified

Common Ionic Charges

+1												+3 ±4 -3 -2 -1					8A
1A	+2											3A	4A	5A	6A	7A	
	2A																
Li ⁺	Be ²⁺											Al ³⁺		N ³⁻	O ²⁻	F ⁻	
Na ⁺	Mg ²⁺											Ga ³⁺			S ²⁻	Cl ⁻	
K ⁺	Ca ²⁺											In ³⁺			Se ²⁻	Br ⁻	
Rb ⁺	Sr ²⁺														Te ²⁻	I ⁻	
Cs ⁺	Ba ²⁺																

Transition metals form cations with various charges



Checkpoint



What is the formula for:

- a) Calcium bromide
- b) Boron nitride
- c) Aluminum chloride

Chemical Names

What is the chemical name of CaBr_2 ?

- In most cases:
 - name of metal + name of nonmetal
 - (change ending of nonmetal to -ide)
- CaBr_2 = calcium bromine
calcium bromine
calcium bromide

Multivalent Elements

- Some transition metals are multivalent (more than one ionic charge)
- Use Roman Numerals to distinguish between the two charges

1A													13					14	15	16	17	8A
	2												3A	4A	5A	6A	7A					
	2A																					
Li ⁺														C ⁴⁻	N ³⁻	O ²⁻	F ⁻					
Na ⁺	Mg ²⁺	3	4	5	6	7	8	9	10	11	12	Al ³⁺		P ³⁻	S ²⁻	Cl ⁻						
		3B	4B	5B	6B	7B	8B			1B	2B											
K ⁺	Ca ²⁺				Cr ²⁺ Cr ³⁺	Mn ²⁺ Mn ³⁺	Fe ²⁺ Fe ³⁺	Co ²⁺ Co ³⁺	Ni ²⁺ Ni ³⁺	Cu ⁺ Cu ²⁺	Zn ²⁺				Se ²⁻	Br ⁻						
Rb ⁺	Sr ²⁺									Ag ⁺	Cd ²⁺		Sn ²⁺ Sn ⁴⁺		Te ²⁻	I ⁻						
Cs ⁺	Ba ²⁺									Au ⁺ Au ³⁺	Hg ₂ ²⁺ Hg ²⁺		Pb ²⁺ Pb ⁴⁺									

Element	Ionic Charge	Chemical Name
Chromium (Cr)	2+ 3+	Chromium (II) Chromium (III)
Manganese (Mn)	2+ 3+	Manganese (II) Manganese (III)
Iron (Fe)	2+ 3+	Iron (II) Iron (III)
Cobalt (Co)	2+ 3+	Cobalt (II) Cobalt (III)
Nickel (Ni)	2+ 3+	Nickel (II) Nickel (III)
Copper (Cu)	1+ 2+	Copper (I) Copper (II)
Tin (Sn)	2+ 4+	Tin (II) Tin (IV)
Lead (Pb)	2+ 4+	Lead (II) Lead (IV)
Gold (Au)	1+ 3+	Gold (I) Gold (III)



Checkpoint



What is the chemical formula for:

- a) Copper (II) chloride
- b) Iron (III) bromide
- c) Nickel (II) oxide

What is the chemical name for:

- d) Fe_2O_3
- e) Cu_2S
- f) FeN

Polyatomic Ions

- Polyatomic Ion – an ion made of more than one atom but acts as a single particle
 - The charge is shared over the entire ion rather than each element
- Ex: PO_4^{3-} = phosphate
- OH^- = hydroxide
- CO_3^{2-} = carbonate

TIP: It may be helpful to keep the elements in brackets and the charge outside the brackets. Ex: $(\text{PO}_4)^{3-}$ or $(\text{OH})^-$

Table 1 Formulas and Charges of Common Polyatomic Ions

Name of polyatomic ion	Ion formula	Ionic charge
nitrate ion	NO_3^-	-1
nitrite ion	NO_2^-	-1
hydroxide ion	OH^-	-1
hydrogen carbonate ion (also called bicarbonate ion)	HCO_3^-	-1
chlorate ion	ClO_3^-	-1
carbonate ion	CO_3^{2-}	-2
sulfate ion	SO_4^{2-}	-2
phosphate ion	PO_4^{3-}	-3
ammonium	NH_4^+	+1

Naming Polyatomic Ions

Write the name of Na_2CO_3

1. Un-criss cross the charges
2. Write the name of the metal and check its ionic charge
3. Write the name of the polyatomic ion and check its ionic charge

= sodium carbonate

Naming Polyatomic Ions

Write the chemical formula for iron(III) nitrate

1. Write the metal and its charge
2. Write the polyatomic ion and its charge
3. Criss-cross the charges
4. Simplify the subscripts



Checkpoint



Name the following:

- a) KNO_3
- b) $(\text{NH}_4)_3\text{PO}_4$
- c) PbCO_3

Write the chemical formula:

- d) Calcium sulfate
- e) Calcium chlorate
- f) Iron(III) phosphate