Name: _____ Class: _____ Date: _____

Molecules and ions

PAGES 40 TO 48

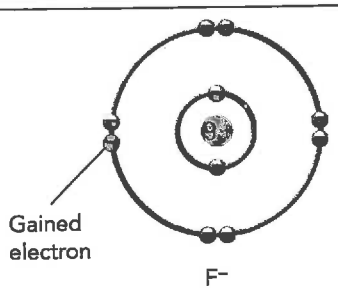
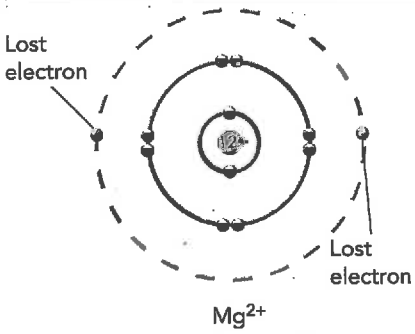
CONCEPT REVIEW 5
Complete this concept review handout and keep it as a record of what you have learned.

CHAPTER 2

Definitions

- A molecule is *a group of two or more chemically bonded atoms.*
- An ion is *an atom that has become electrically charged by losing or gaining one or more electrons.*
- A polyatomic ion is *a group of two or more chemically bonded atoms that has become electrically charged by losing or gaining one or more electrons.*
- A chemical bond is *the union of two atoms through the transfer or sharing of one or more electrons.*
- An ionic bond is *the result of a transfer of one or more electrons from one atom (usually a metal) to another atom (usually a nonmetal).*
- A covalent bond is *the result of the sharing of one or more electron pairs between two atoms (usually two nonmetals).*

Some characteristics of ions

	Negative ion	Positive ion
Loss or gain of electrons	*Gain of one or more electrons.*	*Loss of one or more electrons.*
Number of electrons to protons	*More.*	*Less*
Charge	*Negative*	*Positive*
Representation according to the Rutherford-Bohr atomic model		

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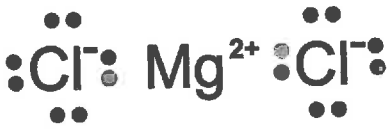
Tendency to gain or lose electrons for group A elements, and examples of possible ions

Group number	I A	II A	III A	IV A	V A	VI A	VII A	VIII A
Number of valence electrons	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8 (except He)*
Tendency	*Lose 1 e^-*	*Lose 2 e^-*	*Lose 3 e^-*	*Gain or lose 4 e^-*	*Gain 3 e^-*	*Gain 2 e^-*	*Gain 1 e^-*	*None (stable)*
Example of possible ion	Li^+	Be^{2+}	B^{3+}	C^{4+} ou C^{4-}	N^{3-}	O^{2-}	F^-	*Ne (or none)*

Examples of common polyatomic ions

Formule chimique	Nom	Formule chimique	Nom
CH_3COO^-	*Acetate*	NH_4^+	*Ammonium*
HCO_3^-	*Bicarbonate*	CO_3^{2-}	*Carbonate*
ClO_3^-	*Chlorate*	CrO_4^{2-}	*Chromate*
OH^-	*Hydroxide*	NO_3^-	*Nitrate*
NO_2^-	*Nitrite*	PO_4^{3-}	*Phosphate*
SO_4^{2-}	*Sulphate*	SO_3^{2-}	*Sulfite*

Types of chemical bonds



Ionic bond _____

Covalent bond _____

Name: _____ Class: _____ Date: _____

The rules of nomenclature and notation

PAGES 48 TO 50

CONCEPT REVIEW 6
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CHAPTER 2

Three rules for writing the chemical formula of a molecule

- *Find the symbol of each element in the molecule by referring to the periodic table.*
- *Determine the order of the symbols. If a binary molecule contains a metal and a nonmetal, the symbol for the metal comes first. In all other cases, symbols are written in the following order: B, Ge, Si, C, Sb, As, P, N, H, Te, Se, S, I Br, Cl, O and F.*
- *Add subscripts after symbols to specify the number of atoms or ions of each element in the molecule.*

Three rules of nomenclature for binary molecules

- *Name the first element.*
- *Change the name of the second element.*
- *Add, when applicable, a prefix or prefixes to specify the number of atoms of each element.*

Some names for the second element in a binary molecule

Name of the element	Name used in nomenclature
Bromine	*Bromide*
Chlorine	*Chloride*
Iodine	*Iodide*
Oxygen	*Oxide*
Sulphur	*Sulphide*

Prefixes indicating the number of atoms of an element in a binary covalent compound

Number of atoms	Prefix
One	*Mono-*
Two	*Di-*
Three	*Tri-*
Four	*Tetra-*
Five	*Penta-*

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Solubility and concentration

PAGES 50 TO 54

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CHAPTER 2

Definitions

- A solution is *a homogeneous mixture whose component substances cannot be distinguished, even with the aid of a magnifying instrument.*
- Solubility is *the maximum amount of solute that can be dissolved in a certain volume of solvent.*
- The concentration of a solution is *the amount of solute in a given amount of solution.*
- The concentration in ppm ("parts per million") is *the number of parts of solute in a million parts of solution.*
- Molar concentration is *the number of moles of solute in a litre of solution.*

Effects of various changes on the concentration of a solution

Change	Effect on the concentration
Dilution (addition of solvent)	*Reduced concentration*
Dissolution (addition of solute)	*Increased concentration*

Mathematical formulas and units of measurement

Formula for calculating concentration in g/L:

$$C = \frac{m}{V}$$

where C *is the concentration (in g/L)*
m *is the mass of the solute (in g)*
V *is the volume of the solution (in L)*

Equivalences for 1 ppm:

$$1 \text{ ppm} = \frac{1}{1\,000\,000}\frac{\text{g}}{\text{g}} = \frac{1}{1000}\frac{\text{mg}}{\text{g}} = \frac{1 \text{ mg}}{1 \text{ kg}}$$

In aqueous solutions:

$$1 \text{ ppm} \approx \frac{1 \text{ g}}{1000 \text{ L}} \approx \frac{1 \text{ mg}}{1 \text{ L}}$$

Formula for calculating molar concentration:

$$C = \frac{n}{V}$$

where C *is the concentration (in mol/L)*
n *is the amount of solute (in mol)*
V *is the volume of the solution (in L)*

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Electrical conductivity and pH

PAGES 55 TO 61

CONCEPT REVIEW 8
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CHAPTER 2

Definitions

- An electrolyte is *a substance that, when dissolved in water, allows an electric current to flow through the solution.*
- The electrical conductivity of a solution is *a measure of its ability to allow an electric current to flow through it.*
- Electrolytic dissociation is *the separation of a dissolved compound into two ions of opposite charges.*

Strength of electrolytes

Strength of the electrolyte	Dissociation	Electrical conductivity	Example
Strong electrolyte	*Nearly complete*	Strong	*Sodium chloride (or NaCl)*
Weak electrolyte	Partial	*Weak*	*Hydrogen fluoride (or HF)*
Nonelectrolyte	*Nil*	*None*	Sugar

Characteristics of the types of electrolytes

Type of electrolyte	Acid	Base	Salt
Definition	*Substance that releases H^+ ions in an aqueous solution*	*Substance that releases OH^- ions in an aqueous solution*	*Substance produced by the chemical bonding of a metallic ion and a non-metallic ion (other than H^+ and OH^- ions)*
Chemical composition	*Generally formed from an H^+ ion and a nonmetal*	*Generally formed from a metal and an OH^- ion*	*Generally formed from a metal and one or more nonmetals*

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Characteristics of the types of electrolytes (*cont.*)

Type of electrolyte	Acid	Base	Salt
Reaction to neutral litmus paper	*Turns neutral litmus paper red*	*Turns neutral litmus paper blue*	*Neutral litmus paper stays purple.*
Examples	• *Fruit juice* • *Soft drinks* • *Gastric juices* • *HCl* • H_2SO_4 • CH_3COOH	• *Cleaning products* • *Heartburn medication* • *NaOH* • $Mg(OH)_2$ • NH_4OH • NH_3	• *NaCl* • $AgNO_3$ • $CaCl_2$ • $CaCO_3$

pH scale

If the pH < 7, the solution is *acidic.*

If the pH = 7, the solution is *neutral.*

If the pH > 7, the solution is *basic.*

pH of some common substances

pH	Acidity or basicity in comparison to a pH of 7	Examples of substances
0	10 000 000 times more acidic	*Hydrochloric acid (HCl)*
1	1 000 000 times more acidic	Gastric juices
2	100 000 times more acidic	*Lemon juice*
3	10 000 times more acidic	*Vinegar, soft drinks*
4	1000 times more acidic	*Tomato juice*
5	100 times more acidic	Rainwater
6	10 times more acidic	Milk
7	Neutral	*Pure water, human blood*
8	10 times more basic	*Seawater*
9	100 times more basic	*Sodium bicarbonate*
10	1000 times more basic	*Soap*
11	10 000 times more basic	*Ammonia cleaner*
12	100 000 times more basic	Lime
13	1 000 000 times more basic	Oven cleaner
14	10 000 000 times more basic	*Sodium hydroxide (NaOH)*