Accompagnement personnalisé — Première S

COVALENT BONDING AND STRUCTURE

DESCRIPTIF DE L'ACTIVITE DESTINE AU PROFESSEUR

Compétences exigibles du B.O.	***Préambule du programme du cycle terminal de la voie S :*** […] en devant présenter la démarche suivie et les résultats obtenus, l'élève est amené à une activité de communication écrite et orale susceptible de le faire progresser dans la maîtrise des compétences langagières, orales et écrites, dans la langue française, mais aussi en langue étrangère, notamment en anglais, langue de communication internationale dans le domaine scientifique. […]
	Programme de première S : Cohésion et transformations de la matière.
Déroulement de l'activité	Cette activité **d'approfondissement** suit l'activité de soutien portant sur les liaisons ioniques. Elle est prévue pour une durée d'une heure en séance d'accompagnement personnalisé, en classe de première S. ***Déroulement :*** • Le document est donné aux élèves qui en prennent connaissance. • Selon les difficultés rencontrées, le professeur leur remet, si besoin, une fiche « coup de pouce » permettant de pallier les difficultés de compréhension liées au vocabulaire. • A la fin de la séance, il est préconisé de distribuer l'une des deux fiches pour s'assurer que l'ensemble des élèves s'est approprié l'activité.
Compétences évaluées	Compétences linguistiques : • compréhension écrite de la langue anglaise ; • expression écrite. En plus des compétences linguistiques, cette activité permet de travailler les compétences de la démarche scientifique : • s'approprier (APP) • analyser (ANA) • réaliser (REA)
Remarques	Cette activité peut se décliner selon trois niveaux de compétences : • niveau 1 : une fiche « coup de pouce » permet de donner le vocabulaire nouveau (ou qui pose problème) directement en français (fiche 1). • niveau 2 : le vocabulaire nouveau est introduit sous forme écrite par le biais de fiche « coup de pouce » proposant les définitions en anglais (fiche 2). • niveau 3 : le vocabulaire nouveau (ou qui pose problème) est explicité oralement par l'enseignant.
Auteurs	Séverine Leget – Lycée Marceau – Chartres Delphine Pailler – Lycée Paul-Louis Courier – Tours Florence Trouillet – Lycée Claude de France – Romorantin

COVALENT BONDING AND STRUCTURE

Compétences travaillées (capacités et attitudes) :

- **APP :** mobiliser ses connaissances, extraire des informations utiles.
- **ANA** : exploiter des informations ; adopter une démarche explicative.
- **REA :** appliquer une consigne donnée.

INTRODUCTION

Ionic bonds are usually found in compounds that contain metals combined with non-metals. For example, consider what happens when sodium and chlorine combine to make sodium chloride:

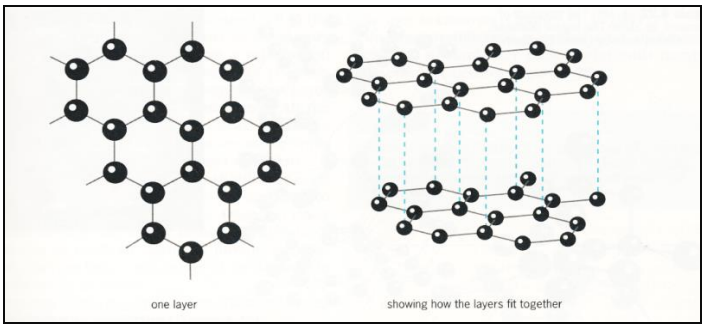
sodium + chlorine → sodium chloride

The charges on the sodium and chloride ions are equal but opposite. They balance each other and the resulting formula for sodium chloride is NaCl. These oppositely charged ions attract each other and are pulled, or bonded, to one another by strong electrostatic forces. This type of bonding is called "ionic bonding".

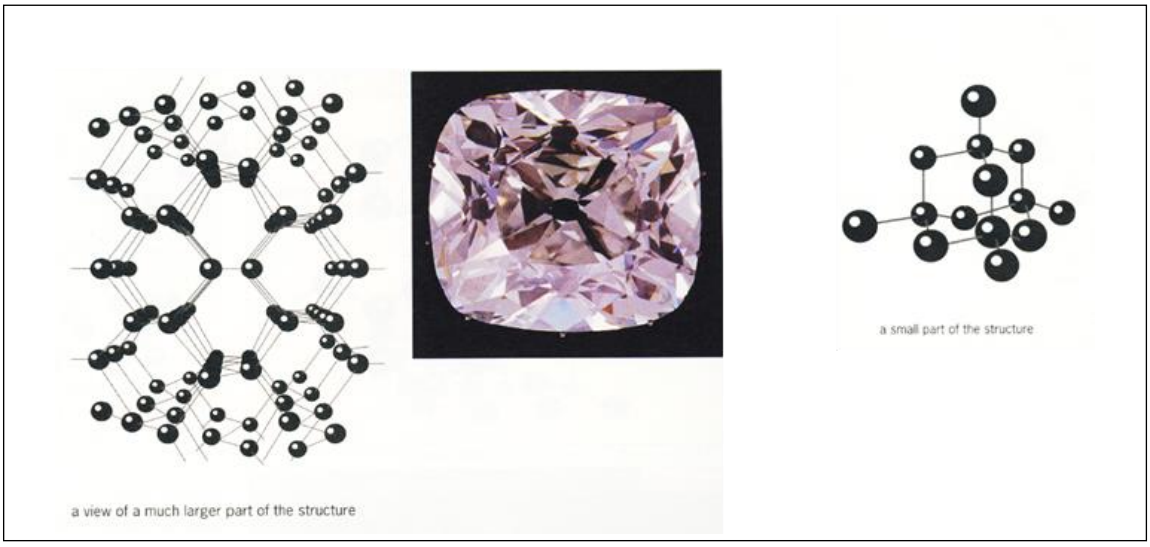
Another way in which atoms can bond together is by sharing electron(s). This occurs between non-metal atoms, and the bond formed is called a covalent bond. The simplest example of this type of bonding is the hydrogen molecule H_2. Each hydrogen atom has one electron, and the molecule of hydrogen is formed by sharing this pair of electrons between those two hydrogen atoms. Generally, covalent compounds do not conduct electricity when molten or dissolved in water. This is because they do not contain ions.

CARBON, AN EXAMPLE OF ATOM BOUND COVALENTLY

Carbon is a non-metallic element present in all organic molecules.
In nature, it is a material which exists in more than one solid structural form, these forms are called allotropes. Allotropes of carbon are graphite and diamond. Each of these allotropes has a different structure *(Figures A and B)* and so the allotropes exhibit different physical properties that lead allotropes being used in different ways.



(A) A portion of the graphite structure.



(B) The structure of diamond, and the regent Diamond, on occasion worn by Queen Elisabeth II.

Property	Graphite	Diamond
Appearance	A dark grey, shiny solid	A colorless transparent which sparkles in light
Electrical conductivity	Conducts electricity	Does not conduct electricity
Hardness	A soft material with slippery feeling	A very hard substance
Density ($g.cm^{-3}$)	2.25	3.51

(C) Physical properties of graphite and diamond.

QUESTIONS

(a) Complete the table giving examples of the use of carbon graphite and carbon diamond.

Graphite	Diamond

(b) How many bonds does carbon have in diamond and graphite?

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(c) Comparing both structures (Figures A and B), explain why graphite is slippery instead of diamond.

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(d) Having a look at each arrangement of the lattice and the number of bounds around each carbon (Figures A and B), determine which is the hardest. Justify.

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(e) - Give the electronic structure for Carbon $_6C$. ……
How many outer electrons does it have? ……

- In the case of graphite, how many covalent bonds are there around an atom of carbon? ……

With these two data, explain why graphite can conduct electricity.

……

……

(f) The density of a material is defined as its mass per unit volume. Thus, what can you deduce about the number of carbon atoms in a small volume of graphite, compared to diamond?

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ANSWERS

(a) Complete the table giving examples of the use of carbon graphite and carbon diamond. (APP)

Graphite	Diamond
Pencils Electrodes Lubricant	Jewels Glass cutters Diamond-studded saws Polishers

(b) How many bonds does carbon have in diamond and graphite? (APP) 3 bonds in graphite and 4 in diamond.

(c) Comparing both structures (*Figures A and B*), explain why graphite is slippery instead of diamond. (ANA) In graphite, carbon atoms are arranged in layers. There are only weak forces between the layers so they can slide over each other quite easily. When we write with a pencil, some layers of carbon atoms slide off the pencil and are left on the paper.

(d) Having a look at each arrangement of the lattice and the number of bounds around each carbon (*Figures A and B)*, determine which is the hardest. Justify. (ANA) The atoms in diamond cannot slide like this because of their arrangement in the lattice, moreover, each carbon atoms in diamond is bonded to four others, cons three for graphite, so the structure is reinforced in the diamond case.

(e) - Give the electronic structure for Carbon $_6$C. (REA) $(K)^2$ $(L)^4$
How many outer electrons does it have? Four outer electrons
(*For example: $_1$H has one outer electron, $_{16}$O has six outer electrons, $_9$F has seven outer electrons…)*

- In the case of graphite, how many covalent bonds are there around an atom of carbon? (ANA) There are only three covalent bonds formed between carbon atoms within the layers, consequently, an unbounded electron is present on each carbon atom.

With these two data, explain why graphite can conduct electricity. (ANA) An important property of graphite comes from the fact that there are free electrons within its structure, and these free electrons allow graphite to conduct electricity (which diamond simply cannot do). Free electrons found in graphite are called “delocalized electrons”.

(f) The density of a material is defined as its mass per unit volume. Thus, what can you deduce about the number of carbon atoms in a small volume of graphite, compared to diamond? (ANA)
Diamond density is bigger than graphite density; therefore, the mass of carbon atoms in a small sample of diamond is bigger than the same mass in a sample of graphite with the same volume. This leads us to the conclusion that in a given sample there will be more atoms in diamond structure than in the graphite one.

bond	liaison chimique
to bond	lier
compound	composé (ici, un solide ionique)
to balance	équilibrer
to pull	tirer
to share	partager
molten	liquéfié
allotrope	allotrope
to exhibit	montrer, faire apparaître une caractéristique
to lead	conduire à, mener à
worn	*pp* “wear” = porter
hardness	dureté
shiny	brillant
soft	mou
slippery	glissant
colorless	incolore
to sparkle	étinceller
outer electrons	électrons de valence

bond	the way in which atoms are held together in a chemical compound.
to bond	to join two things firmly together. *The atoms bond together to form a molecule.*
compound	a substance formed by a chemical reaction of two or more elements in fixed amounts relative to each other. *Common salt is a compound of sodium and chlorine.*
to balance	to have equal totals of atoms and charges, in the reagents and in the products.
to pull	to use a force to move something towards yourself. *I pulled on the rope to make sure that it was secure.*
to share	to divide something between two or more people. *We shared the pizza out between the four of us.*
molten	made liquid by very great heat (used about metal or rock).
allotrope	the ability that certain substances have to exist in more than one physical form.
to exhibit	to show clearly that you have a particular quality, or a particular feeling. *The refugees are exhibiting signs of exhaustion and stress.*
to lead	to have something as a result.
worn	*pp* “wear”.
hardness	to quantify what is not soft to touch, not easy to break or to bend.
shiny	something causing a bright effect when in the sun or in the light. *The shampoo leaves your hair soft and shiny.*
soft	not hard or firm. *A soft bed.*
slippery	when a surface is difficult to walk on because it is smooth or wet**.** *A slippery floor.*
colorless	without any color.
to sparkle	to shine with many small points of light. *The river sparkled in the sunlight.*
outer electrons	electrons which are in the outer shell ; in the highest energy level.