Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ IPad # \_\_\_\_\_\_\_\_\_\_

**TOPIC # 4**

**CHEMICAL BONDING**



**Textbook Chapters 7 & 8**

**Answer Key**

**Part I-Ionic Bonding**

**Using the glossary in your textbook, define *ionic bonding*.**

**Describes the electrostatic attraction that binds oppositely charged ions together.**

**Page 199**

#2 An atom loses valence electrons.

#3 An atom gains valence electrons.

#4 Atoms of which elements tend to gain electrons? Nonmetals

Atoms of which elements tend to lose electrons? Metals

#7 a. 1 b. 4 c. 2 d. 6

**Page 207**

#13 Ionic compounds are generally solids at room temperature, have high melting points, and conducts electricity when melted (molten state) or dissolved in water.

#14 a. K2S

b. CaO

c. Na2O

d. AlN

#16 Acceptable answers should describe a solid containing positive sodium ions and negative chloride ions.

#17 The ions are free to move.

#19 c & d

**PRACTICE DRAWING LEWIS DOT DIAGRAMS FOR IONIC COMPOUNDS**

|  |  |
| --- | --- |
| CHEMICAL FORMULA | LEWIS DOT STRUCTURE |
| **KCl** | Macintosh HD:Users:alicezagelbaum:Desktop:Screen Shot 2015-08-17 at 4.40.52 PM.png |
| **NaBr** | Macintosh HD:Users:alicezagelbaum:Desktop:Screen Shot 2015-08-17 at 4.41.17 PM.png |
| **MgBr2** | Macintosh HD:Users:alicezagelbaum:Desktop:Screen Shot 2015-08-17 at 4.41.43 PM.png |
| **AlF3** | Macintosh HD:Users:alicezagelbaum:Desktop:Screen Shot 2015-08-17 at 4.42.07 PM.png |
| **Ca3P2** | Macintosh HD:Users:alicezagelbaum:Desktop:Screen Shot 2015-08-17 at 4.42.40 PM.png |

**Part II-Metallic Bonding**

**Using the glossary in your textbook, define *metallic bonding*.**

**Describes the force of attraction that holds metals together; it consists of the attraction of free-floating valence electrons for positively charged metal ions.**

**Page 212**

#20 Metal cations surrounded by a sea of mobile valence electrons

#22 Malleable: Can be hammered into different shapes

Ductile: Can be drawn into wires

#23 Under pressure, the cations in a metal slide past each other. The ions in ionic crystals are forced into each other by the rigid structure.

#25 Alloy: Sterling Silver (92.5% Ag and 7.5% Cu)

Uses: Jewelry

Alloy: Bronze (7 parts Cu and 1 par Sn)

Uses: Making Statues and Monuments

**Review of Ionic and Metallic Bonding**

**Page 214-215**

# 41 a, b, d

#45 Their network of electrostatic attractions and repulsions forms a rigid

structure.

#46 Ions are free to move in molten MgCl2

#51 The properties of the steel will vary according to its composition. In addition to iron, steel can contain varying amounts of carbon and such metals as chromium, nickel, and molybdenum.

#63 a. 1s22s22p63s23p6 c. 1s22s22p63s23p6

b. 1s22s22p63s23p6 d. 1s22s22p63s23p6

What did you observe?

All have the same electron configuration as neon.

**Page 216-217**

#70

a. Fe2O3 c. Li2O

b. PbO2 d. MgO

#77 By gaining or losing electrons the atoms of elements achieve a noble-gas

electron configuration.

#84 Removal of the first electron results in a very stable electron configuration.

Removing a second electron would disrupt that stability.

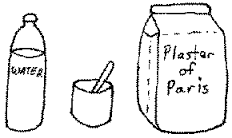
#85 a. zinc b. 38 neutrons

**Pearsons SuccessNet On-line**

Explore Cave Crystals by watching the video online.

Gypsum and Selenite are examples of ionic compounds having the same chemical formula. What makes them different?

**The arrangement of the ions in the crystal**

****

**Part III - Covalent Bonding**

**Using the glossary in your textbook, define *covalent bonding*.**

**Describes a bond formed by the sharing of electrons between atoms.**

**Page 225**

#2 The representative unit of a molecular compound is a molecule. The representative unit of an ionic compound is a formula unit.

#5 nitrogen (N2) or oxygen (O2)

**Page 238**

#12 The shared electron pair comes from one of the bonding atoms. In other covalent bonds, each bonding atom provides an electron.

#14 A large bond dissociation energy corresponds to a strong covalent bond.

#15 They are used to envision the bonding in molecules that cannot be adequately described by a single structural formula.

#18 The arrangement of atoms in a molecule.

**Page 246**

#22 To predict the three-dimensional shapes of molecules.

**Page 253**

#31 The more electronegative atom attracts electrons more strongly and gains a partial negative charge. The less electronegative atom has a partial positive charge.

#34 The atom in CCl4 are oriented so that the bond polarities cancel.

#36 The atoms in a network solid are covalently bonded in a large array (or crystal)

#38 In dipole interactions, the slightly positive end of a polar molecule attracts the slightly negative end of another polar molecule. Dispersion forces arise from the movement of electrons in any molecule, polar or nonpolar. If the electrons in one molecule happen to be momentarily more on one side, the electrons in a neighboring molecule can be repulsed. Weak attractions can result between the temporary dipoles.

**Page 256**

#43 b, c, and e

#44 Neon has an octet of electrons. A chlorine atom achieves an octet by sharing an electron with another chlorine atom.

#55 Bond dissociation energy is defined as the energy needed to break one

covalent bond.

#56 Increasing the bond dissociation energy is linked to lower chemical

reactivity.

#57 a. 4 b. 8 c. 6

**Page 257**

#68 More energy is required to separate the molecules.

#75 a. The percent ionic character increases as the difference in

electronegativities increases.

b. 1.6

c. Li &O 85% N & O 10% Mg & Cl 23%

**Page 258**

#81 Answers can vary. Table 8.3 suggests that there is no clear difference.

The student’s argument could be based on chemical properties, such as

conductivity of the compound in the liquid state.

#85 False. The bond dissociation energies exhibit no particular trend and in

fact, are fairly constant.

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**Chapter 8 🡪8.2(Nature of Covalent Bonding) 🡪Kinetic Art (Covalent Bonds)**

**Observe the molecule building of H2, F2, H2O, NH3, and CH4 and answer questions online.**

**PRACTICE DRAWING LEWIS DOT DIAGRAMS FOR MOLECULAR SUBSTANCES (COVALENT BONDING)**

***\*\*Please note that bond type refers to polarity of the bond between two atoms.***

***Molecule type refers to the polarity of the entire molecule (SNAP)***

***Shape of molecule …choose from linear, bent, tetrahedral, etc…***

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| CHEMICAL  FROMULA | LEWIS DOT  STRUCTURE | STRUCTUAL  FORMULA | SHAPE OF  MOLECULE | POLARITY  BOND TYPE | POLARITY  MOLECULE  TYPE  (SNAP) |
| **Br2** | Macintosh HD:Users:alicezagelbaum:Desktop:Screen Shot 2015-08-17 at 4.43.16 PM.png | Macintosh HD:Users:alicezagelbaum:Desktop:Screen Shot 2015-08-17 at 4.43.25 PM.png | **Linear** | Nonpolar | Nonpolar |
| **HF** | Macintosh HD:Users:alicezagelbaum:Desktop:Screen Shot 2015-08-17 at 4.49.24 PM.png | Macintosh HD:Users:alicezagelbaum:Desktop:Screen Shot 2015-08-17 at 4.49.29 PM.png | **Linear** | Polar | Polar |
| **H2O** | Macintosh HD:Users:alicezagelbaum:Desktop:Screen Shot 2015-08-17 at 4.51.13 PM.png | Macintosh HD:Users:alicezagelbaum:Desktop:Screen Shot 2015-08-17 at 4.51.21 PM.png | **Bent** | Polar | Polar |
| **CF4** | Macintosh HD:Users:alicezagelbaum:Desktop:Screen Shot 2015-08-17 at 4.37.54 PM.png | Macintosh HD:Users:alicezagelbaum:Desktop:Screen Shot 2015-08-17 at 4.46.14 PM.png | **Tetrahedral** | Polar | Nonpolar |
| **NH3** | Macintosh HD:Users:alicezagelbaum:Desktop:Screen Shot 2015-08-17 at 4.52.26 PM.png | Macintosh HD:Users:alicezagelbaum:Desktop:Screen Shot 2015-08-17 at 4.52.34 PM.png | **Pyramidal** | Polar | Polar |
| **CO2** | Macintosh HD:Users:alicezagelbaum:Desktop:Screen Shot 2015-08-17 at 4.53.44 PM.png | Macintosh HD:Users:alicezagelbaum:Desktop:Screen Shot 2015-08-17 at 4.53.52 PM.png | **Linear** | Polar | Nonpolar |
| **N2** | Macintosh HD:Users:alicezagelbaum:Desktop:Screen Shot 2015-08-17 at 4.56.43 PM.png | Macintosh HD:Users:alicezagelbaum:Desktop:Screen Shot 2015-08-17 at 4.56.50 PM.png | **Linear** | Nonpolar | Nonpolar |

**DO YOU KNOW THE DIFFERENCE?**

Using your textbook and notes from class complete the following table.

|  |  |
| --- | --- |
| TYPES OF SOLIDS | CHARACTERISTICS OF SOLIDS |
| Metallic  List 3 examples:  Cu  Mg  Ag | Hard, high melting points  Conducts electricity in solid phase |
| Ionic  List 3 examples:  CuCl2  MgO  AgF2 | Hard, high melting points, do not conduct electricity as solid, good conductors in aq or liquid phase |
| Molecular  List 3 examples:  **I2**  **C6H12O6 (glucose)**  **CO2(s)(dry ice)** | Soft, low melting points, poor to non conductors |
| Network  List 2 examples:  Diamond, SiC, SiO2 | Very hard, very high melting points, poor to non conductors |

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**Go to Chapter 8 🡪 8.4 (Polar Bonds & Molecules) 🡪 Kinetic Art (Polar Molecules)**

**Understanding Intermolecular Forces of Attractions Between Polar Molecules**

**Answer the questions online after you have completed the activity**

**Part IV- Intermolecular Forces of Attraction (IMF’S)**

Using your textbook and notes from class complete the following table.

|  |  |
| --- | --- |
| **IMF’S**  **INTERMOLECULAR FORCES OF ATTRACTION** | **CHARACTERISTICS** |
| **DIPOLE- DIPOLE**  **ILLUSTRATE AN EXAMPLE USING HBr** :  H-Br ---- H-Br ---- H-Br | Attractions between opposite ended charges of a polar molecule |
| HYDROGEN BONDING  ILLUSTRATE AN EXAMPLE USING HF :  H-F ---- H-F ---- H-F --- H-F | Very strong dipole forces found between molecules when hydrogen is bonded to either fluorine, oxygen or nitrogen |
| **VAN DER WAALS FORCES**  **(LONDON DISPERSION)**  **ILLUSTRATE AN EXAMPLE USING I2:** | Weak forces of attraction found between either nonpolar molecules or noble gases. Gets stronger as the molecules get closer together or get larger. |
| MOLECULE-ION  ILLUSTRATE AN EXAMPLE USING KCl(aq) : | Attractive force between ions and polar ends of polar molecules. Happens when an ionic substance dissolves in water |

**Chemical bond discovered that only exists in space**

July 2012 by Nicola Guttridge

There's a new bond in town, and this secret agent works best in extreme situations.

The bond, of the chemical variety, occurs in the presence of very strong magnetic fields, such as those found around ultra-dense white dwarf stars. Its discovery not only demonstrates the existence of an unfamiliar and exotic type of chemistry, it may also give insight into the behaviors of these mysterious stellar bodies.

White dwarfs are the remnant cores of low-mass stars that have exhausted all their fuel. They are thought to be the final state for most of the stars in our galaxy. Though they have masses comparable to that of our sun, white dwarfs only occupy the same amount of space as a small planet like Earth, making them incredibly dense.

They also exhibit super-strong magnetic fields on the order of 100,000 tesla – 10 billion times greater than Earth's magnetic field, and 10 million times greater than that of an average refrigerator magnet. This intense field can affect the behavior of the electrons that make up chemical bonds.

**Exclusion Principle**

On Earth, atoms usually bond either covalently, by sharing electrons with neighboring atoms, or ionically, via electrostatic attractions created by the transferal of electrons.

The Pauli exclusion principle governs the electrons that give rise to these bonds: two cannot occupy the same quantum state simultaneously. To avoid this scenario, electrons in bonds normally pair up in couples of opposing spin. But under the intense magnetic field of a white dwarf, "this spin interacts with the external field, acting like a little magnet," says lead author Kai Lange at the University of Oslo in Norway.

As a result, the spins of both electrons align with the external field, forcing one of the electrons to move into a different position known as an anti-bonding orbital. Normally, this would spell the end of any chemical bonds. "In a normal molecule these anti-bonding orbitals are not occupied by electrons," says Lange. "If they are occupied, the atoms are no longer bound together and the molecule breaks apart."

**Unfamiliar chemistry**

Lange and his colleagues wondered if things might be different around white dwarfs. "Chemistry and molecular physics become very different in the presence of a strong magnetic field," says Erik Tellgren, Lange's colleague. "Even very simple systems behave in exotic and unfamiliar ways compared to what we are used to under normal conditions."

With this in mind, the researchers used quantum chemical simulations to model chemical bonding in hydrogen and helium atoms in the magnetic field of a white dwarf. In both cases, the atoms were drawn into strongly bonded pairs.

Because the electrons in these bonded atoms occupied anti-bonding orbitals – which is forbidden in both types of known chemical bond – the researchers say this is a new type of bond. They have dubbed it "perpendicular paramagnetic bonding".

The work shows that "molecules that don't exist under normal conditions can exist in a sufficiently large magnetic field," says Lange.

David Clary of the University of Oxford, who was not involved in the study, called the research "excellent", adding "the results show that a magnetic field can stabilize molecules".

**Reading the stars**

Although the authors say that replicating the new bonds on Earth isn't feasible, the finding highlights how molecular chemistry may change in the presence of extreme conditions.

"I think there are probably other weird or unfamiliar types of bonding to be discovered," says Tellgren.

Such work will also help to further our knowledge of astrophysical objects like white dwarfs. By understanding how matter behaves around these objects, it may be possible to interpret their observed spectra more easily and accurately, and to better unravel what is happening in their atmospheres.

1) The new type of bond works under what type of conditions?

The new bond works under the presence of very strong magnetic fields.

2) What does the intense magnetic field affect in the atom?

It affects the arrangement of the electrons in the atom

3) What happens normally, in an atom, when an electron enters an anti-bonding orbital?

The atom will no longer be able to bond

4) Why did scientists use Hydrogen and Helium to simulate the bonding instead of another element?

They are the simplest atoms containing the fewest amounts of electrons.